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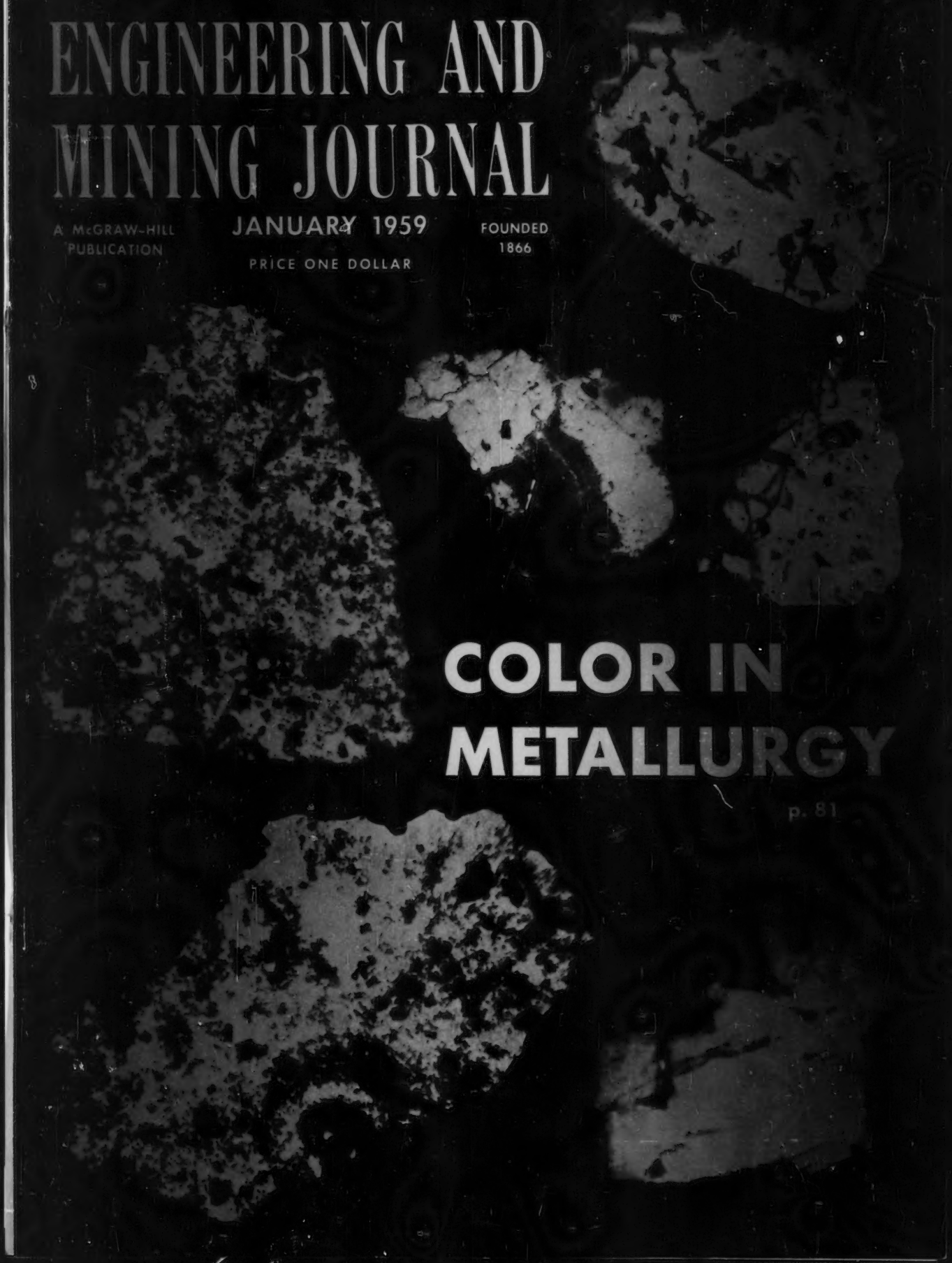
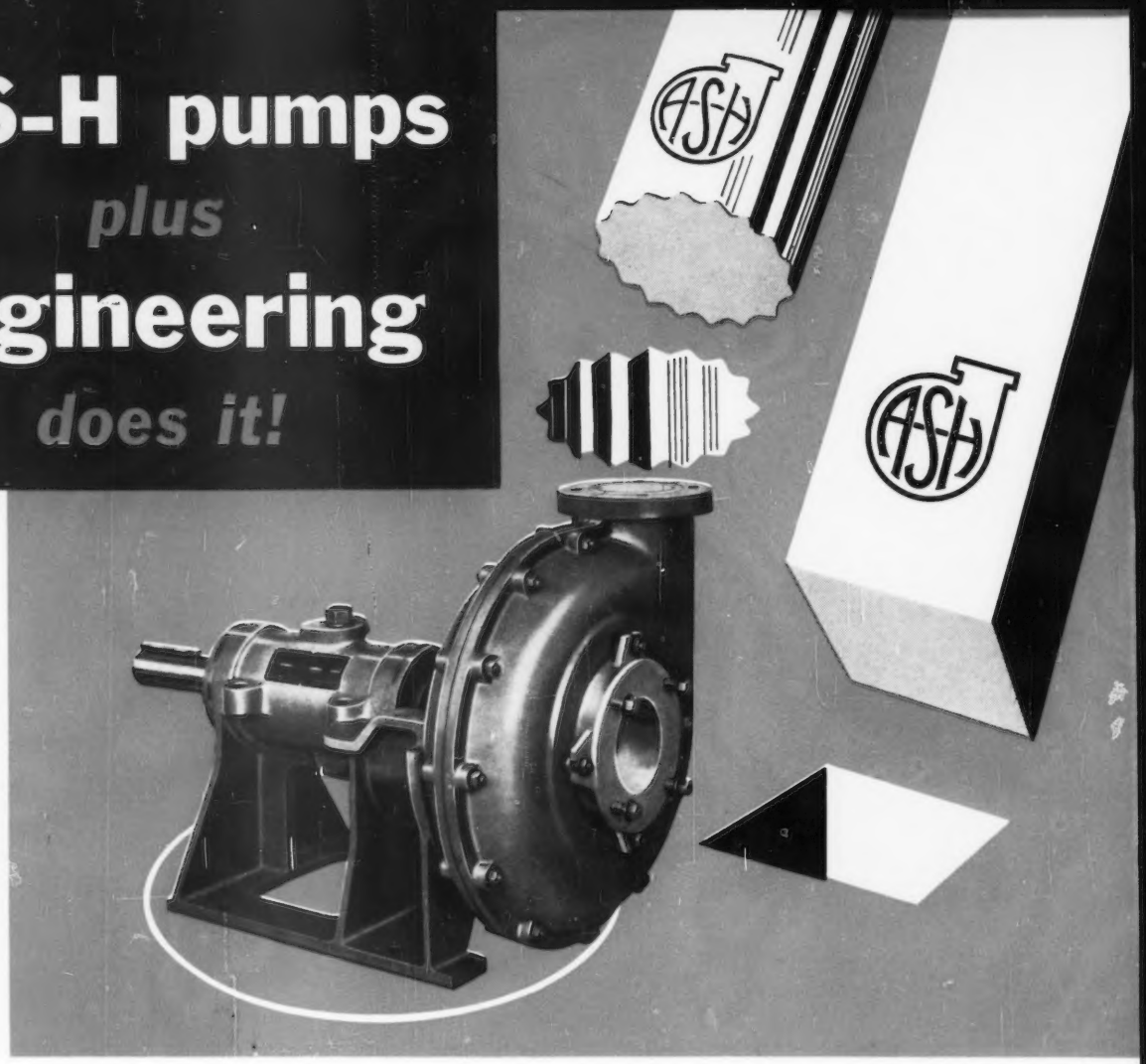


COLOR IN METALLURGY

p. 81

A-S-H pumps *plus* engineering *does it!*



Round pegs in round holes, square pegs in square holes, and irregular pegs to fit irregular holes symbolize the accomplishments of A-S-H pumps in mining and processing plants throughout the world.

The reason for accomplishment is no secret. A life-long practice of keeping performance records of almost every A-S-H pump sold provides our engineers with a vast continuing store of pumping lore. From this have come new pumps of remarkable flexibility, and the know-how with which to adapt the flexible factors to extraordinary pumping conditions. Thus it is that A-S-H engineering—through design and application—helps handlers of abrasive and corrosive materials achieve greater pumping efficiency and lower operating costs.

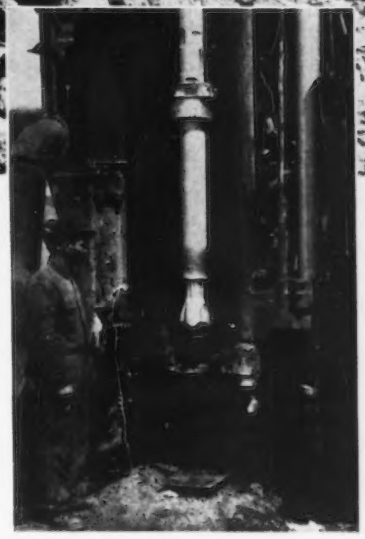
As a first step toward solving your pumping problem—write us for your copy of our

Brochure No. 357

containing nomographs instead of tables for determining the correct type and size of pump.

THE ALLEN-SHERMAN-HOFF PUMP CO.
Dept. B—259 E. Lancaster Ave., Wynnewood, Pa.
Representatives throughout the World

HYDROSEAL and CENTRISEAL
SAND, SLURRY & DREDGE PUMPS
MAXIMIX RUBBER PROTECTED



"DOWN THE HOLE DRILL"

Boosts Net Tonnage 200%

Churn drill—53 net tons per hr.
Piston drill—152 net tons per hr.
Down-the-hole drill—464 net tons per hr.

A large Eastern trap rock quarry operated for years with churn drills drilling 6 inch holes on a 16′ x 18′ spacing at the rate of 2 feet per hour. Purchasing a Quarrymaster using a QD-8 piston drill and 6″ Carset bits, net tonnage per hour increased from 53 to 152 tons.

Last summer another Quarrymaster employing an Ingersoll-Rand DHD-400 down-the-hole drill using 7″ bits was put in operation. Overall drilling speed even with the larger bit was doubled and hole spacing increased from 16′ x 18′ to 20′ x 22′! Results—464 net tons per hour.

All drilling was in a hard massive trap rock economically undrillable by any other big hole drilling method. Ask your I-R man for complete information and other cost saving examples of Quarrymaster performance.

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ENGINEERING AND MINING JOURNAL

93rd YEAR OF PUBLICATION

JANUARY 1959

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Extra-tough hose for rugged jobs is also light, easy to handle

THAT hose carries air and water to a drill, breaking up chunks of ore in a lead mine. The hose is dragged across sharp, abrasive rock. It's twisted and bent. It's subjected to hot air from the compressor. Such abuse would shorten the life of most rubber hose. But not the B.F.Goodrich Commander air hose pictured here.

The cover of this B.F.Goodrich air hose is made with a tough, oilproof rubber. It stands rough treatment, has high resistance to scuffing, cutting, gouging, tearing. Special wire-braid reinforcement makes this hose stronger, tougher—helps it take higher pressures, provides a greater safety factor.

The lining of B.F.Goodrich Commander air hose is made with a special rubber compound that stands hot air, won't harden, crack, or break into gummy particles to clog tools. Strong and rugged as this air hose is, it is still light enough to be carried around without effort, extremely flexible so that it handles easily, doesn't tire workers.

Where to buy: Your B.F.Goodrich distributor has exact specifications on the B.F.Goodrich Commander air hose. And, as a factory-trained specialist in rubber products, he can answer your questions about *all* the rubber products B.F.Goodrich makes for the mining industry. *B.F.Goodrich Industrial Products Company, Department* **M-501,** *Akron 18, Ohio.*

B.F.Goodrich *air hose*

Behind the By-Lines...

We've kidded about for years, ninety-three of 'em to be exact, about presentation of the information in *E&MJ* in Glorious Technicolor. Well, sir, by golly, we've made it.

Our Man in charge of casting the negative vote has held that the use of color in an article where it is not functional can be sheer (as he put it) waste. We've never argued the point because we agree, and because he's a lot bigger than we are.

But lo, there has been a happy joining of technical information, cooperative author, imaginative printing and, bless our soul, functional use of color. When came time for consideration of E.P. Cadwell's "Color Microscopy for the Mill Man," the affirmative vote of Our Man led all the rest.

The article begins on p 81, and would be an excellent contribution to mining and milling technology if merely it ran its informative course in good old black and white. But, thanks to Mr. Cadwell's talent with a camera, we've been able to add four (count 'em, four) pages of color slides which make his point more graphically than yards of text could do.

We suggest you trot right along to p 81 and look the story over. We'll be along in a minute, as soon as Our Man stops waving the issue in our face and shouting, "That's what I mean, functional!"

"This is Flash Gordon, general superintendent of mines, calling Buck Rogers in the pit."

"This is Rogers, go ahead, Flash."

"Buck, could you turn down the juice on the induction breaker for a few minutes? Queen Lobelia is having trouble with her handy-dandy combination hair curler and garbage disposal unit."

"Why doesn't she call the power company? We're trying to maintain a million ton-per-day output here, and we can't do it if every interstellar monarch with straight hair and an excess of leftovers comes charging in and using our power line."

"Gad, Rogers, would you have Jupiter involved in an interplanetary incident for the sake of a few thousand tons of rock? Why don't you blast and crush the rock for an hour or so?"

"Blast and crush? Whazzat?"

The above dialogue, friends, is not out of Captain Billy's Whiz Bang, or any other of our leading publications. It was inspired by the announcement of an induction breaking machine (p 80), which, its discoverers believe, can efficiently mine taconite ore merely by socking it with an electromagnetic charge and then scooping it out with a bulldozer. As our oldest son keeps informing us, not without impatience, "It's the 20th Century, Dad!"

A really effective maintenance program depends upon two major factors: Cooperation with the manufacturer of the equipment involved, and an imaginative and alert maintenance and repair crew.

We're illustrating the point this month with a special report on the techniques and tools of maintenance in the pit, the shop and the mill.

Maintenance: Part I is devoted to recommendations for welding techniques and types of anodes and other equipment. You'll find applications throughout your mine and mill plant. Another title in Part I concerns sharpening drill bits. It's a simple, illustrated one-page job that can save you money.

Part II concerns the second point in our thesis: That an alert and imaginative maintenance and repair crew is your best weapon in the war with high costs.

The team at Carey Rock Salt Co. has built a base for a preventive maintenance program by careful record keeping and wise distribution of authority. The records are simple, and designed for a small mine operation. One benefit which Carey discovered, and certainly one worth your attention, was that operators could be encouraged to make their own simple repairs once they understood the importance of the job.

A crew of contenders in the tradition of the Navy's SeaBees is working out of the machine shop at Bunker Hill. How they have smoothed out corrugated rails, rebuilt pumps, improved hoist operation and generally done the impossible without taking much more time makes an exciting story. Maintenance: Part I starts on p 70 and the second installment begins on p 94.

We're as vulnerable as the next guy. (In fact, the guy next to us in individual standings at the Rocky Hills Curling, Whirling and Skirling Club is Wilfred McK. Vulnerable, of the Hurricane, Utah, Vulnerables. But we digress.)

It is our condition of vulnerability that makes us hold back whenever we are witness to an example of the genus: typographical error. (There's a story there, too. Our Printer could make our ears burn if he told you some of the fluffs that we've tried to pass off as printing errors. But we digress again.)

Reluctant as we are to point out another's typographical (sic) error, we feel we just have to pass along the following headline, and wild horses couldn't make us divulge the periodical in which it originated.

Bingham to Supply Salacious Ore

It seems that an outlying village in Malaya was suffering innumerable depredations by a bear which had been severely burned in a forest fire and was unable to obtain food in a normal bear-like manner. One injury resulting from the flames was that the bear's feet had been deformed, and his footprints resembled those of a young human male.

A Chinese dealer in teakwood, Chan Du, maintained a small warehouse on the outskirts of the village and eventually he, too, suffered a financial loss when the deformed animal broke into his storehouse and made off with a portion of his inventory.

A hunting party was organized and spent two days unsuccessfully in the bush. They returned to the settlement and were met at the gate by a wild-eyed resident who waved his arms and called to them, "Come with me, for I have seen the boy-foot bear with the teaks of Chan!"

The following is reprinted in its entirety from the *Borzoi Quarterly*, published by Alfred A. Knopf:

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zanzeris orziz?

Special report to Caterpillar owners:

Parts you can trust. Dependable, round-the-clock service.

PROOF OF THE DIFFERENCE IN THE CAT "HI-ELECTRO" HARDENED CUTTING EDGE

Whether loading scrapers or bulldozing, the cutting edge takes more punishment than any other part of the machine—more punishment today than ever before. New, larger, more powerful machines put greater demands on cutting edges. And the edge that's holding up best and lasting the longest is the Cat "Hi-Electro" hardened cutting edge—the edge with the difference. From all over the country, documented results from on-the-job comparative tests with other makes of edges confirm this fact. The best buy is the Cat edge.

ROUGH JOBS like this put cutting edges to severe tests. And here is where tough Caterpillar edges prove their superiority.

• • •

Field tests prove that the edge with the difference, the Cat cutting edge, not only outwears other make edges of the same thickness; it even outlasts the thicker edges of other manufacturers. The reason: Caterpillar engineers perfected a hardening process to give steel the right blend of toughness and hardness —toughness to prevent breaking, hardness to prevent bending and rapid wear.

• • •

Quality edges start with quality steel, tested in Caterpillar's laboratories for the right chemical composition and physical characteristics. Only steels meeting these exact specifications are accepted, and further tests are made at every stage of production.

CROSS SECTION of edge showing armor-like case and its shock-absorbing core.

NOW AVAILABLE—NEW MULTI-SECTION 'DOZER EDGES

New multi-section 'dozer edges developed by Caterpillar for the D8 and D9 show the way to reduced blade costs and easier blade changing. Reduced blade costs can result from piece-by-piece replacement. You can now reverse and replace the worn sections. Changing is easier than ever before.

• • •

Service tip: When installing new or reversing "Hi-Electro" hardened edges, clean all dirt from the matching surfaces. Be sure that all bolt heads are properly drawn in to their holes and correct nut torque applied. This assures proper cutting edge support and maximum strength.

• • •

Your Caterpillar dealer has the complete story on the advantages of using the new Cat multi-section 'dozer edges. He backs you with dependable, round-the-clock service and parts you can trust. See him today!

NEW EDGES are now available for the D8 Bulldozer in left and right sections shown here. New edges for the D9 come in left, center and right sections.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR

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It's a good feeling to see

on your **STAINLESS**

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Valves of corrosion resistant stainless steels have been made to those high standards by Jenkins for a quarter of a century. And today, the line of Jenkins Stainless Steel valves includes types and alloys to fully satisfy most service requirements.

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JENKINS VALVES JENKINS SINCE 1864

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☐ Have a representative call on me

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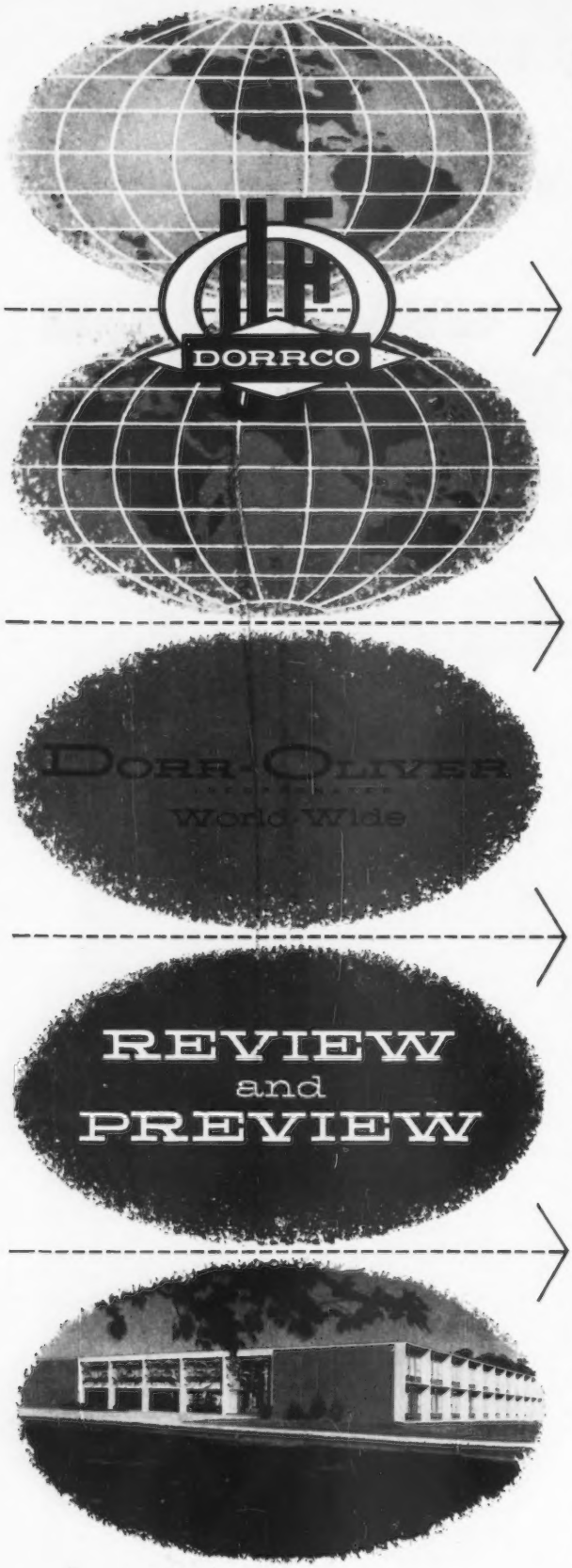

1958 has been a year of healthy consolidation. The generally lower level of new business we have had in common with most capital goods companies has given us a much needed opportunity to examine all our operations with the emphasis on sharpening efficiencies and stepping up the rate of our technological advance. In both, we have made substantial gains.

The sharpening of efficiencies is evidenced by a number of changes. Our manufacturing costs and delivery times are both noticeably better. A reorganization of our Research & Development group has resulted in a greater emphasis on basic research and a speeding up of development of new processes and equipment. This will ultimately include more and better manpower in both these areas. We have simplified routines, eliminated many nonessential operations and projects which seem to creep in during boom times. This allows us to proceed with less staff, but a more able and experienced one.

The current lag in new business has been much less noticeable overseas, and we have been concerned with a number of very large and significant projects abroad. Our subsidiaries have continued to progress and are contributing substantially to the financial balance of our consolidated effort.

PLANT ENGINEERING — The year's major project was the design of a 150 metric ton per day triple superphosphate plant for Mexico. This large contract includes process engineering, plant design, purchase of equipment and supervision of construction of the granular fertilizer plant as well as attendant facilities such as labs, cafeteria, offices and guest house.

A second substantial current project, which is being carried out jointly by D-O and one of our subsidiary companies in Europe, is the design of a large Yugoslavian copper concentrator. Also engineered abroad were a Belgian dicalcium phosphate plant and the expansion of a German phosphoric acid plant. During the year a large fertilizer installation in England went into operation and was rapidly brought up to operating capacity. A fertilizer plant in Montana and a copper concentrator in Israel, both D-O designed, were put into operation late in the year.

Latest addition to the list of installations which the company can now design is the board plant. We are staffed and equipped to engineer any of the basic types including wet or dry process hardboard and particle, insulating, gypsum and flake board.

PULP AND PAPER — A Canadian pulp producer will install a complete D-O Bleach Plant, and Bleach Washers will be utilized in expansion of an Indian groundwood mill. Late in the year Brownstock Washing and Recausticizing Systems, Deckers and hypochlorite preparation equipment were ordered for a new French mill. At a second French mill, a large Brownstock Washing System was put into operation in 1958.

Recausticizing Systems will be installed at two other new mills, one producing paper in India and the other linerboard in the western United States. Continued evidence of widespread acceptance of the American Disc Filter has been demonstrated by the number of orders entered for this efficient saveall. Also of interest were filters ordered for local manufacture from our Australian subsidiary and our Japanese representative.

FOOD PRODUCTS — In the citrus industry, Merco Centrifuges and Mercone Screening Centrifuges have been applied to the finish-processing of orange juice prior to concentration. Successful also has been application of

the Centrifuge-Precoat Filter combination to apple juice processing.

Corn starch washing systems consisting of various combinations of centrifugal equipment were ordered for mills in the United States, Colombia, Holland and Mexico. And, as in so many previous years, the sale of RapiDorr Clarifiers and O-C Filters for cane sugar processing has contributed heavily to orders entered.

FLUOSOLIDS SYSTEMS — Applications of the FluoSolids system were broadened in 1958 to include heat treatment or drying of such materials as foundry sand, phosphate base food products and concentrated detergent and for carbon reactivation. Another new application will be partial roasting of sulfide concentrates at one of Canada's largest smelters.

Other FluoSolids projects now in the design stage or under construction are slag dryers for India and Alabama; pyrite roasters for Spain, South Africa and California; a coal dryer for a midwestern producer and two-stage arseno pyrite roasters for installation in the gold fields of northern Canada. Now in operation or under construction around the free world are over 100 FluoSolids installations on such proven applications as sulfide ore roasting, coal and slag drying, and limestone and phosphate rock calcination.

SANITATION — This phase of our business has been particularly active during 1958 both at home and abroad. Over thirty-five installations of the CompleTreator sewage treatment unit, first introduced last year, are now in operation providing treatment facilities for housing developments, industrial plants, and other small centers of population. Equipment for large domestic projects now under construction include Clariflocculators for a chemical precipitation plant in northern New York State, Densludge Thickeners for the nation's capitol, large Digesters and Distributors for Dallas County, and Clarifiers and Distributors for a Biofiltration plant in Kansas.

Abroad, D-O will supply units for two plants in New Delhi, as well as for installations in Venezuela, Iraq and Kenya. North of the border, extensive additions to the metropolitan Toronto treatment system will be D-O equipped.

Major developments in this field have been the SR Clarifier, a new rapid sludge removal mechanism for final clarification in biological treatment, and the D-O Aerator for the activated sludge process. Installations using both units are already in operation, and a major pulp and paper producer has ordered Aerators for a new waste treatment plant.

COAL — Fine coal recovery and water clarification will be accomplished at Eastern and Australian cleaning plants in large Thickeners ordered within the past year. In a number of instances, an American Filter and ODS Pump will complete the fines recovery circuit.

IRON AND STEEL — Proof of the versatility of the DSM Screen is its application at three points in the heavy media cyclone flowsheet. In its first use on the Iron Range it has considerably reduced magnetite losses. In this general field also the Thickener-Filter combination has continued to be widely applied to recovery of blast furnace flue dust.

CHEMICAL — In 1958 new developments highlighted Dorr-Oliver activity in the far-flung chemical industry. Among the foremost of these was the plastic Filter, a rotary drum vacuum unit constructed of plastic with glass fiber reinforcing. Initial orders indicate the applicability and economy of this unit for mildly corrosive applications.

A second major development, the Merco H-30 Centrifuge, provides the chemical industry with a high capacity, high speed unit capable of clarifying up to 600 gallons of slurry per minute. The product of nearly four years of testing, this machine has substantially reduced operating power requirements per gallon of feed. One of the first commercial applications will be crystal separation at 90° below zero.

Result of yet another new design program is the expanded line of Type L centrifugal pumps. Here, three new designs provide increased capacity and head range and reverse inlet flow for operating speeds of both 1750 and 3500 rpm. In addition, Hypalon elastomer lining is now standard for both Olivite and ODS Pumps.

During the year a German manufacturer ordered the eighth and ninth Horizontal Filters for dewatering artificial resins, and domestic producers purchased Horizontals for such applications as washing ammonium sulfate and nitrocellulose and filtering potash and copperas. Also in the potash field was use of the DSM Screen for debrining crystallizer underflow.

GENERAL METALLURGICAL — Development of an air-lift agitation system for the American Filter has provided a third method of maintaining heavy solids in suspension prior to filtration. Complementing the conventional paddle and swing agitators, this new method has been extensively tested at operating installations.

U. S. and Chilean producers have ordered giant Thickeners with the strongest turntables ever fabricated, and a copper mill in the Belgian Congo will utilize ten large vacuum Filters in a current expansion. New construction at U. S. cement plants includes the three largest Slurry Mixers ever furnished, each 120 feet in diameter, as well as a variety of smaller machines.

WATER — Here also new construction and plant expansions resulted in application of a variety of D-O pretreatment equipment. Two large Hydro-Treator mechanisms will supplement four additional units already in operation at Miami, Florida; and Topeka, Kansas will utilize Presedimentation Clarifiers and Flocculators. PeriFilter systems will be installed at Peoria, Illinois and Leander, Texas; and in Mexico City the first PeriFilter of a new, simplified control design is now going into operation.

Not the least of our gains in efficiency has resulted from new and vastly improved headquarters facilities both here and abroad. Our new International Headquarters was completed here in Stamford in July, the staff of D-O NV expects to move its own new office building in Amsterdam shortly, and our associates in both Brussels and Paris are enjoying new and excellent facilities in co-operatively owned buildings.

In every respect, we are better prepared than ever before to take advantage of the upswing to come and to give better service to our customers throughout the world. This betterment, of course, could only have come about by the diligent and co-operative efforts of our total staff, and to them belongs the credit for the work done.

J. D. Hitch, Jr.
President

November 5, 1958

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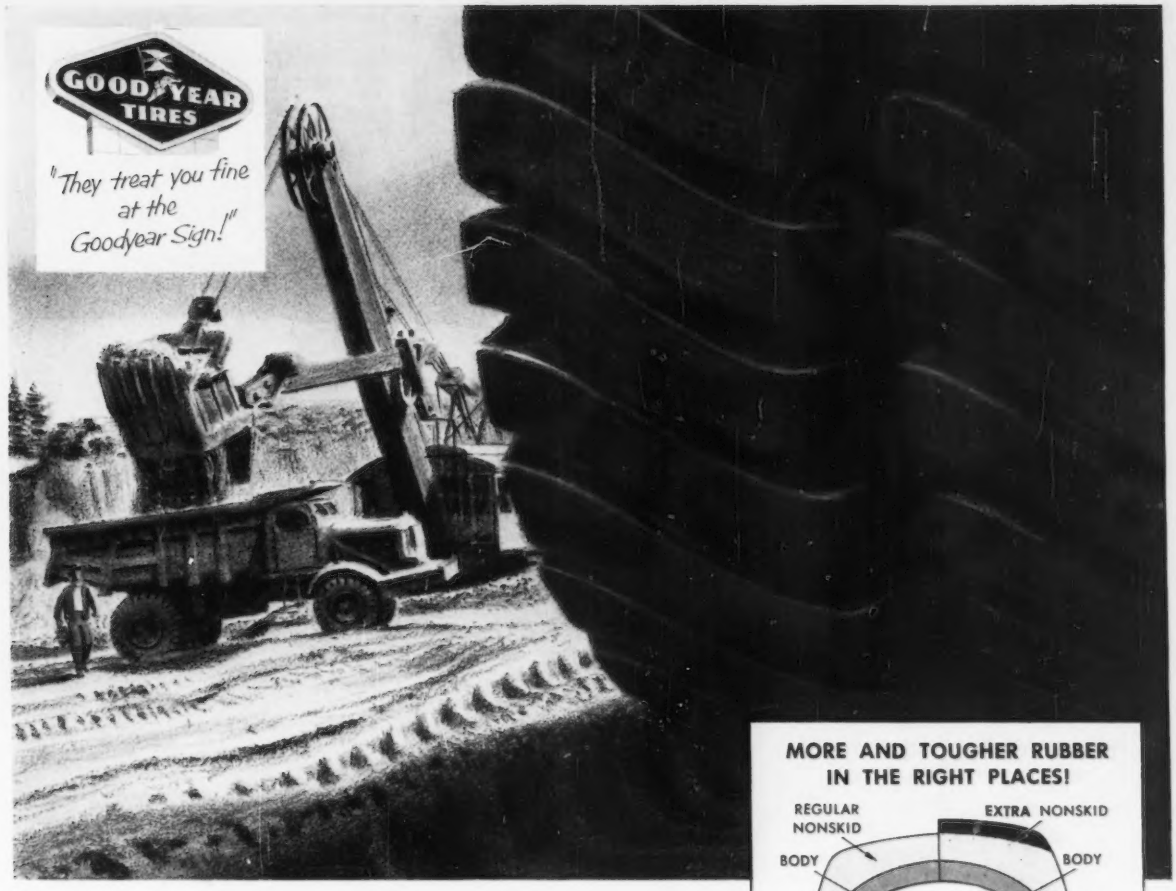
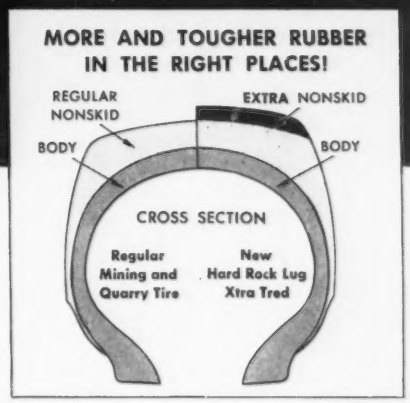




ALL THERE FOR LONG WEAR

NEW HARD ROCK LUG XTRA TRED <u>has</u> it where mining and quarry tires <u>need</u> it!

The new Hard Rock Lug Xtra Tred is designed and built *specifically* for mine and quarry work.

Precise engineering of extra tread-rubber–extra-tough – results in up to 50% longer tread life! Reinforced lugs, bonus shoulder heft and huskier sidewalls endure unbelievably tough punishment.

And all this standout new tire engineering is backed by a body of Goodyear's exclusive Triple-Tough 3-T Nylon Cord–reduces bruise-breaks and blowouts to an all-time low–the greatest tire *saver* in 24 years!

Better check into the new Hard Rock Lug Xtra Tred–at your Goodyear dealer's NOW! Goodyear, Truck Tire Dept., Akron 16, Ohio.

GOODYEAR

MORE TONS ARE HAULED ON GOODYEAR TRUCK TIRES THAN ON ANY OTHER KIND

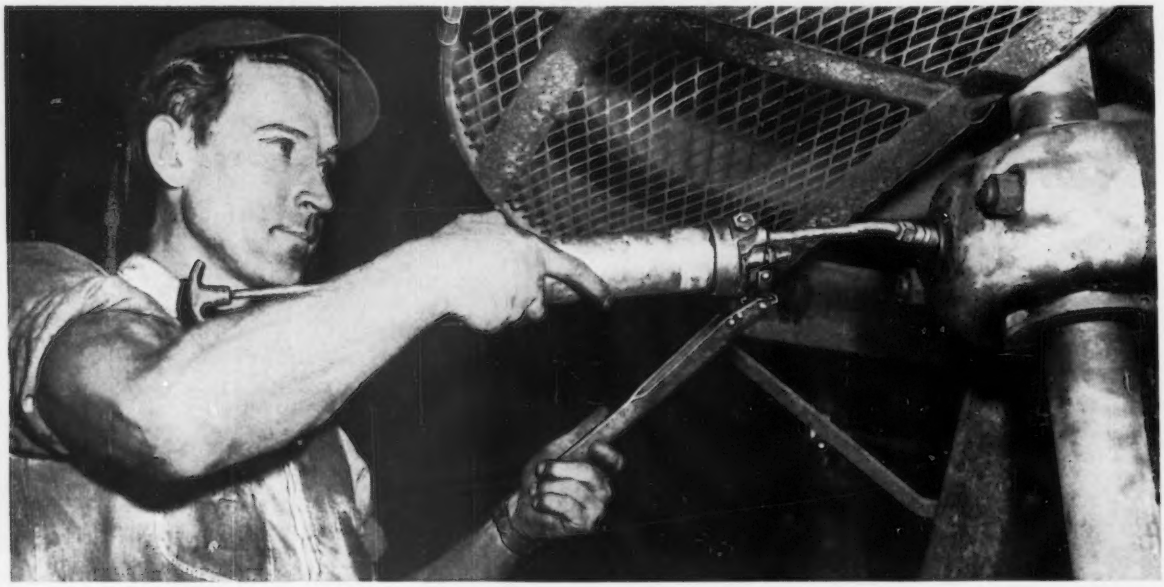
Xtra Tred–T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

ENGINEER'S FIELD REPORT

PRODUCT CHEVRON INDUSTRIAL GREASE

FIRM CALERA MINING CO. Cobalt, Idaho

Bearings last 800% longer using Chevron grease



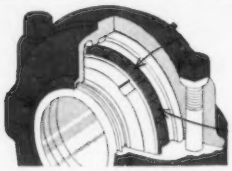
Escaping 240° steam caused bearing failures in only 2 months on this ore conditioner at Calera Mining Co. until firm changed to Chevron Industrial Grease. Now, identical bearings lubricated with this moisture—high temperature-resistant grease last 18 months, 800% longer...need lubrication just once each 24 hours instead of 3 times every 8-hour shift. Bearings are pillow blocks for 17½' impeller shaft which churns ground cobalt ore with steam, air and lime to aerate it prior to differential flotation.

Mill Foreman J. O. Vecchies (right) and V. Fliflet, Standard Oil Representative, stand on 15' diameter ore conditioner to examine bearings and impeller drive. Replacing these 3-3/16" taper roller bearings is a 4-hour, 2-man job, and shuts down entire mill. Increased bearing life with Chevron Industrial Grease saves the equivalent of 64 hours labor, with a corresponding increase in productive capacity. Mill is only source of cobalt in Western Hemisphere. Firm has used Chevron Industrial Grease since 1955.

CHEVRON Industrial Lubricants

TRADEMARKS "CHEVRON" AND CHEVRON DESIGN REG. U.S. PAT. OFF.

Why Chevron Industrial Grease provides superior lubrication



- Top wear-prevention qualities
- Pumpable over wide temperature range
- Mixes with any grease
- Extreme work stability
- Melting point, 500°F. plus
- Rust protection
- Non-corrosive
- Unusual water resistance

For More Information on Chevron Industrial Grease or any other petroleum product, or the name of your nearest distributor, write or call any of the companies listed below.

STANDARD OIL COMPANY OF CALIFORNIA
225 Bush Street • San Francisco 20, California

THE CALIFORNIA COMPANY
P. O. Box 780 • Denver 1, Colorado

STANDARD OIL COMPANY OF TEXAS
P. O. Box 862 • El Paso, Texas

LET'S TALK ABOUT EASE.. OF SHOVEL OPERATION

It was Northwest that pioneered the movement in the direction of ease of Shovel and Crane operation back in the days when operators had to *stand* at the controls on other machines.

To maintain full day operator efficiency, Northwest engineers developed and pioneered the "Feather-Touch" Clutch Control. This device utilizes the power of the engine to throw the heavy Drum Clutches. Over the years the "Feather-Touch" Clutch Control has been refined and improved to a high point of efficiency.

Here, ease of operation is made possible by a simple, understandable, mechanical device—just a drum and brake band and the necessary linkage—nothing more. It is completely free of complicated and delicate mechanisms. There are no long lines of tubing, no pumps, no compressors or valves — nothing to fill! It is unaffected by weather or temperature and it requires no special knowledge or outside help for adjustment. The action of the clutch is in direct ratio to the movement of the operating lever and the operator does not have to maintain pressure on the operating lever to keep the clutch engaged. It is extremely sensitive and the *true feel of the load* is always present. Release is positive and straight manual control can be introduced at any time.

On a Northwest the operator knows where he is every second of his operating cycle. At once he has smooth, effortless control with freedom from the maintenance problems that come with complicated control devices. This means greater output and greater profit for the contractor. The "Feather-Touch" Clutch Control is pictured in detail in Northwest catalogs. We'll be glad to send you one on the size machine you need.

NORTHWEST ENGINEERING COMPANY
1509 Field Bldg., 135 South LaSalle Street, Chicago 3, Illinois

S-60-75-LG

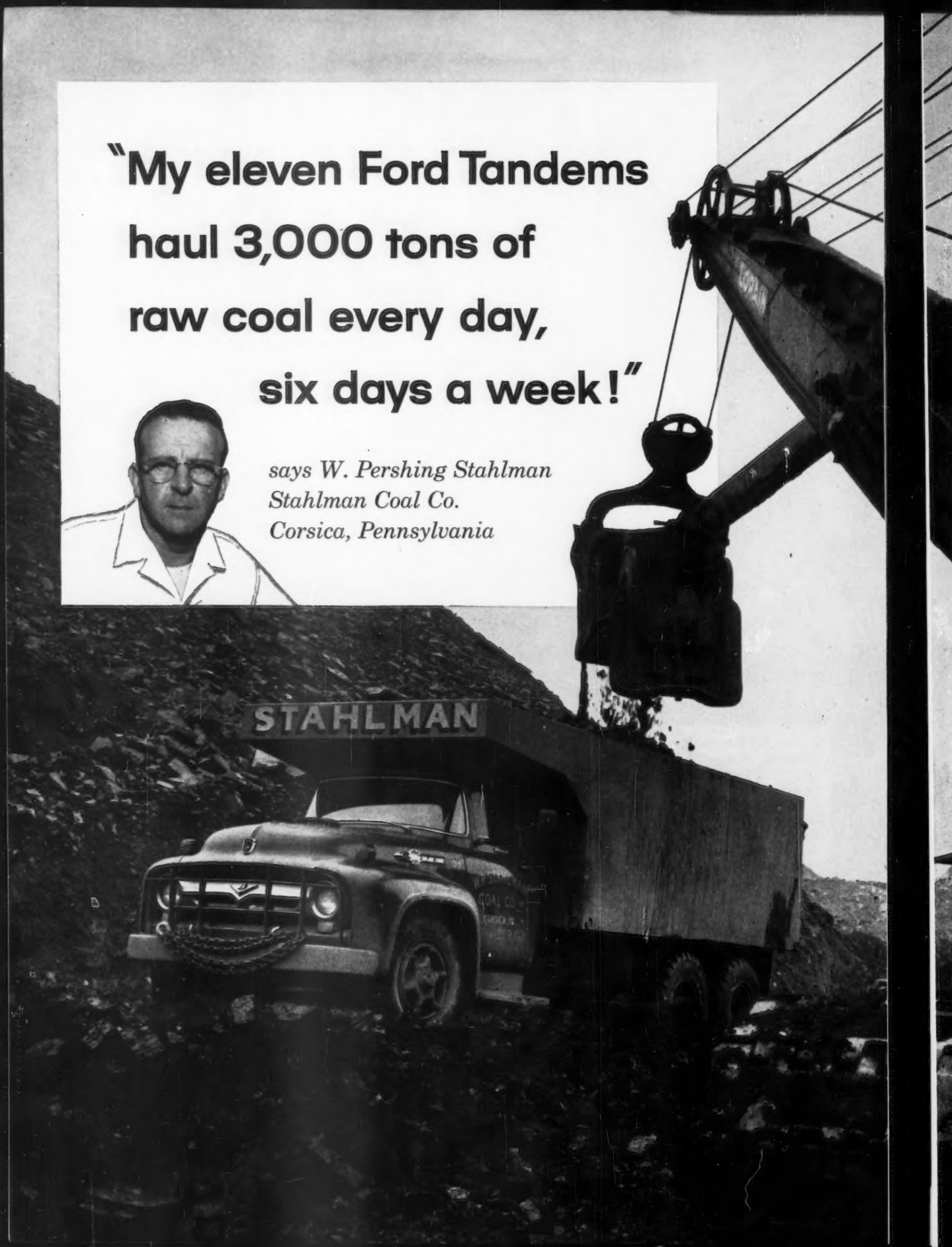
NORTHWEST *Always Ready to* GO

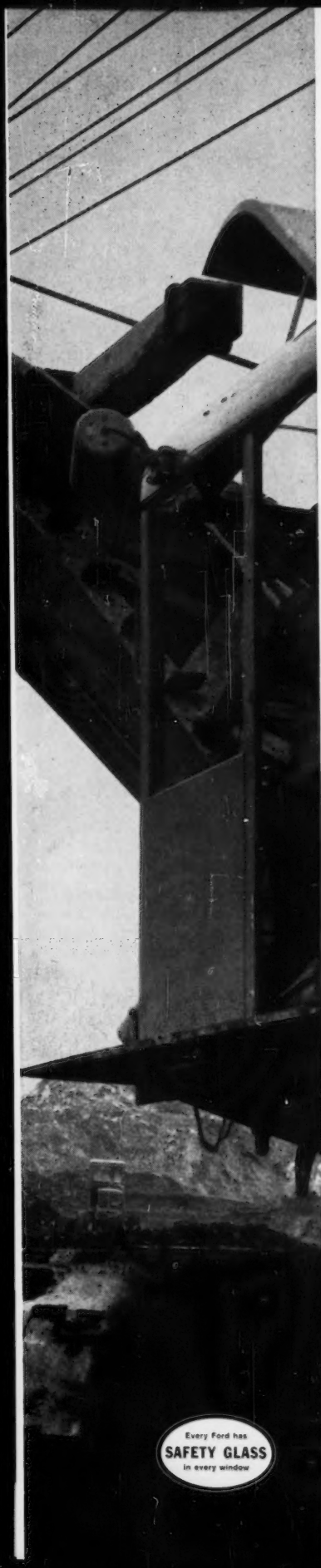
NORTHWEST EQUIPMENT IS BUILT IN THE FOLLOWING SIZES

SHOVELS	CRANES	DRAGLINES	PULLSHOVELS	TRUCK CRANES
¾ Yd. to 2½ Yd. Capacity	13-Ton to 50-Ton Capacity	¾ Yd. to 3 Yd. Capacity	¾ Yd. to 2½ Yd. Capacity	25-Ton and 35-Ton Capacity

"My eleven Ford Tandems haul 3,000 tons of raw coal every day, six days a week!"

says W. Pershing Stahlman
Stahlman Coal Co.
Corsica, Pennsylvania





Every Ford has
SAFETY GLASS
in every window

"I can't afford unreliable equipment. And rough going doesn't bother my Fords. Many have over 200,000 miles on 'em!

"My Ford tandem fleet hauls raw coal from three strip mines to the washing plant and loading bins. Working 10,000 acres, and feeding one of the largest washing plants in the country calls for super-dependable trucks. They must climb steep grades coming out of the pits with 18-ton payloads. It's a tough operation, requiring lots of brute power and stamina. Ford Heavies really do the job, and with a minimum of expense.

"Power steering is a wonderful Ford tandem feature. My drivers like the handling ease it gives on mud and shale roads.

"22 years of experience in the trucking business has taught me the value of Fords. And I've got 2 new '59 Ford T-800's on order."

Go Ford-ward for savings with '59 Ford Trucks!

NEW FORD 4-WHEEL DRIVE PICKUPS are excellent personnel and equipment carriers for punishing off-road and mining operations.

Whatever your job . . . wherever you do it—you'll find Ford Heavies and Extra Heavies are engineered and built to do it better! And the '59 improvements in these models give you still more benefits.

Factory installed tractor package custom-fitted to Ford trucks for safer, more dependable braking.

New internal shoe parking brake has nearly 50% greater stopping and holding ability, requires less than half the operating effort needed for previously used type.

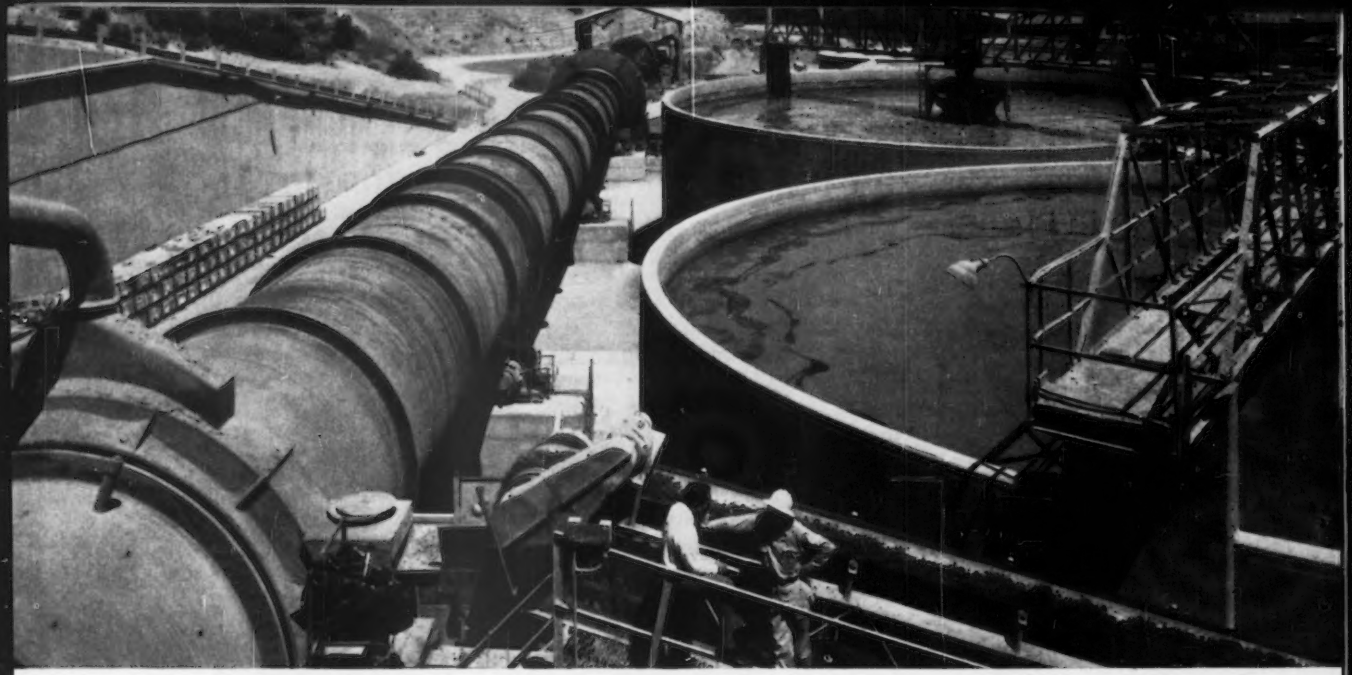
Higher payloads and longer axle life with new, higher capacity front and rear axle options.

Greater operating economy with faster axle ratios and wider choice of transmissions.

Yes, the new '59 Ford trucks are here to take you *Ford*-ward for savings, *Ford*-ward for modern style and stamina. See your Ford Dealer today!

FORD TRUCKS COST LESS

LESS TO OWN . . . LESS TO RUN . . . LAST LONGER, TOO!



G-E SYSTEM ENGINEERING assistance helped reduce construction time and costs on Permanente Cement Co. plant expansion.

NEW BALL MILLS at Permanente Plant are powered by heavy-duty General Electric synchronous motors. Speed-torque characteristics of this 1000-hp motor are matched to the mill to give more dependable starting under specific power system conditions at this plant. G-E motor design provides reliable performance, maximum safety and ease of maintenance.

INDIVIDUAL FIELD EXCITATION for existing and new synchronous ball mill drives is supplied by efficient G-E motor-generator sets. Triple-protected Tri-Clad* motors, combined with job-matched d-c generators provide a more economical, faster-responding power source.

AT PERMANENTE CEMENT CO., G-E EQUIPMENT HELPS . . .

Boost Plant Capacity 1,500,000 bbls./year

The addition of a sixth kiln and three new ball mills at Permanente Cement Company's huge Permanente, California, plant boosted output by 1,500,000 barrels per year. This expansion, necessitated by increased demands from the Company's western states and Pacific islands market brings plant capacity to 8,500,000 barrels per year.

Engineering responsibility for the expansion lay with Kaiser Engineers. Working together with General Electric Application Engineers on a coordinated system basis, they utilized the latest engineering techniques to obtain optimum performance at reduced cost and construction time.

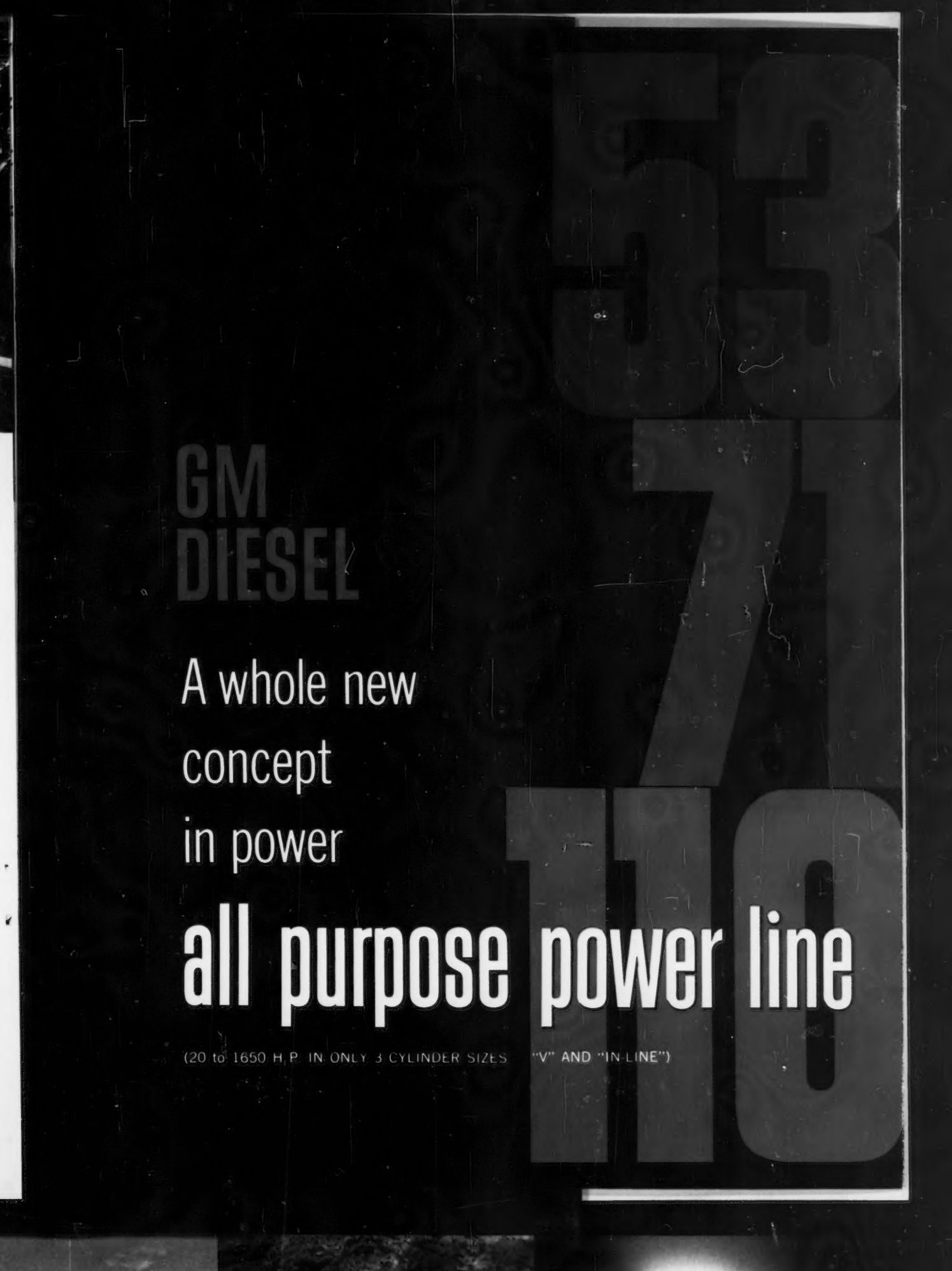
To achieve maximum savings on your plant expansion program, call on General Electric early in your planning stage. Your nearby G-E sales engineer will be happy to assist you, anytime. General Electric Company, Schenectady 5, New York. 658-22

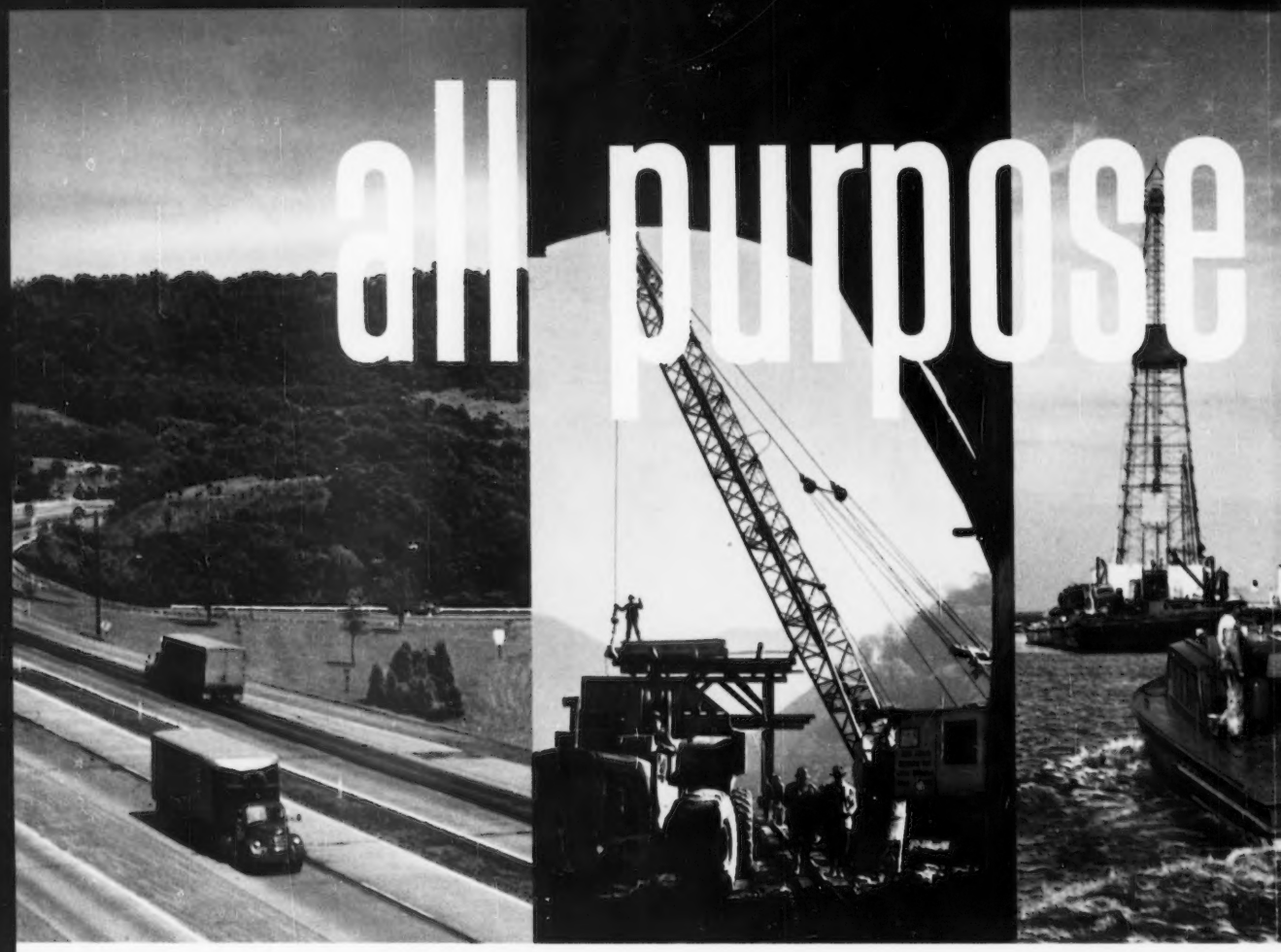
Engineered Electrical Systems for the Cement Industry

GENERAL ELECTRIC

G-E MOTOR CONTROL CENTER (r.) centralizes operation of precipitator and auxiliary motors for greater convenience and safety. Limitamp* 2300-v controllers (l.) are for induced draft fan motor and for transformer supplying 480-v power to motor-control center.

* *Registered Trade-mark of General Electric Co.*


GM
DIESEL
A whole new
concept
in power
all purpose power line
(20 to 1650 H.P. IN ONLY 3 CYLINDER SIZES "V" AND "IN-LINE")
53
71
110



GM Diesel combines 8 New Basic "V" and "in-line" engines with

To help industry fill its power needs, GM Diesel engineers have developed the most comprehensive power concept since they pioneered the small 2-cycle Diesel.

Using only 3 cylinder sizes, they have more than doubled the number of basic engines – vastly increased the horsepower range – yet maintained the family relationship and parts interchangeability for which GM Diesels are famous.

Each engine features the ultimate in *compactness, light weight, high efficiency, durability and inexpensive maintenance.*

Basing their design on that of the versatile and capable GM Series 71 Diesel, GM Diesel engineers have created 8 new basic "V" and "in-line" engines which will add vastly new power coverage to the present Series 71 and 110.

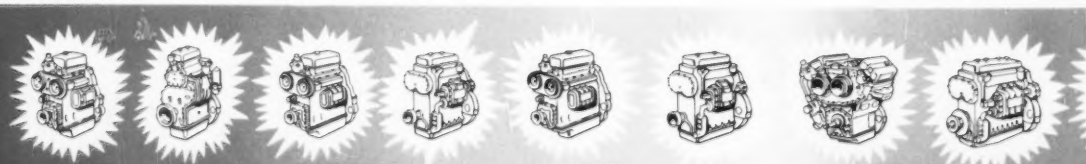
First, the new Series 53 Diesel—comprising four basic "V" and "in-line" engines—is a smaller, more compact version of the famous "71."

Here, at last, in the Series 53, are Diesels which cover the lower horsepower ranges as never before. They hurdle the barriers which have limited the use of Diesel power in a whole host of applications. They offer new opportunities for Diesel power to farmers, boatowners and industrial users by making available GM Diesels particularly suited to their needs. They will pay for themselves amazingly fast when they take over from gasoline engines.

Four new "V-71" engines complete the additions—widen the power range of the "in-line" 71 Series—set new standards for low weight and small size per horsepower. These "V-71"

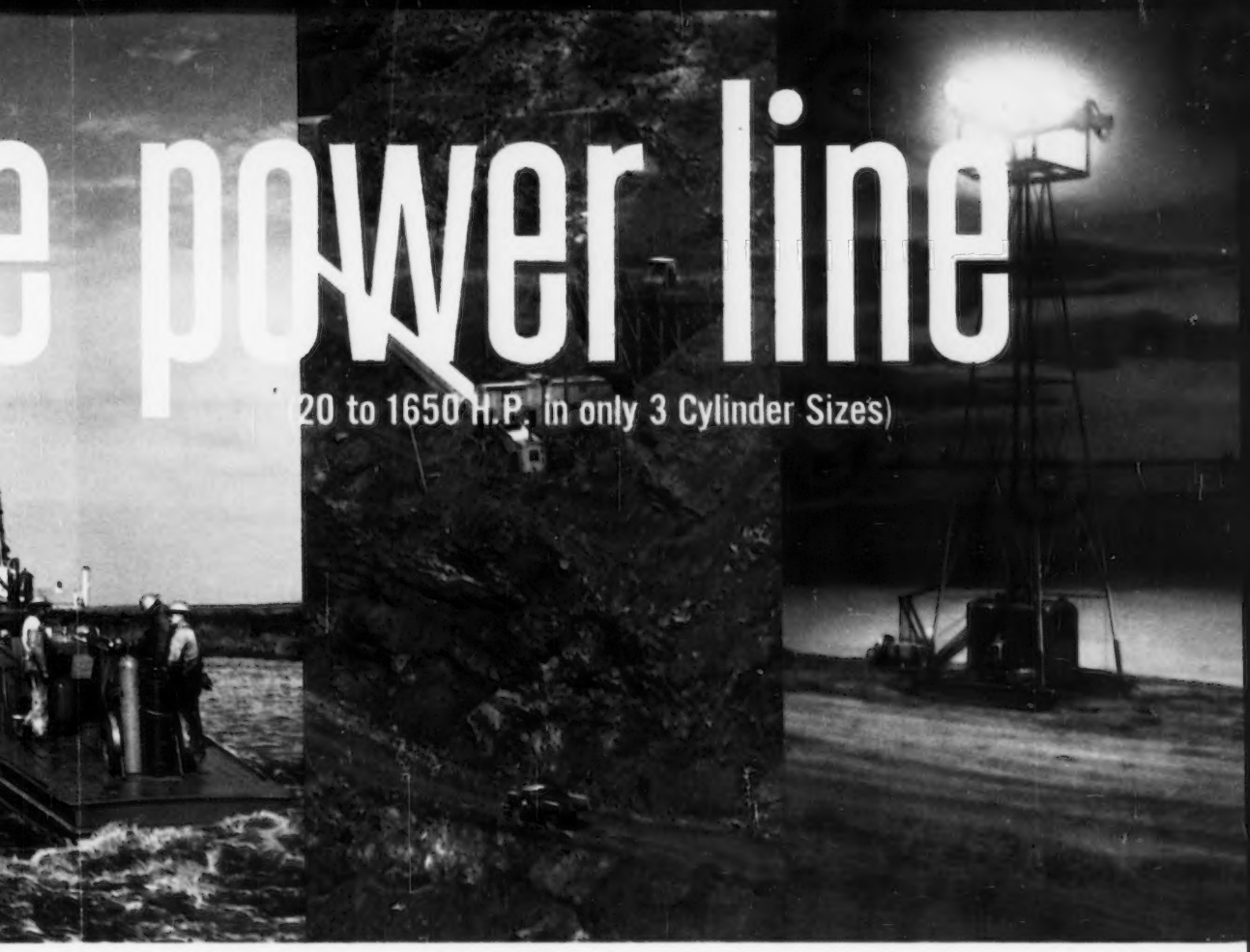
The GM Diesel All-Purpose Power Line 20 to 1650 H.P. in only 3 cylinder sizes

NON-TURBOCHARGED RATINGS



"2-53"	"2-71"	NEW "3-53"	"3-71"	NEW "4-53"	"4-71"	NEW "6V-53"	"6-71"
20 to 47 H.P.	33 to 67 H.P.	38 to 97 H.P.	51 to 118 H.P.	51 to 130 H.P.	69 to 167 H.P.	76 to 195 H.P.	112 to 252 H.P.

NOW, A "JIMMY" DIESEL



with its proved "Jimmy" Diesels

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"V-71"

engines bring far more power than ever before possible to the big brutes of the construction, mining, petroleum, logging and marine industries—up to 1650 H.P. when turbocharged.

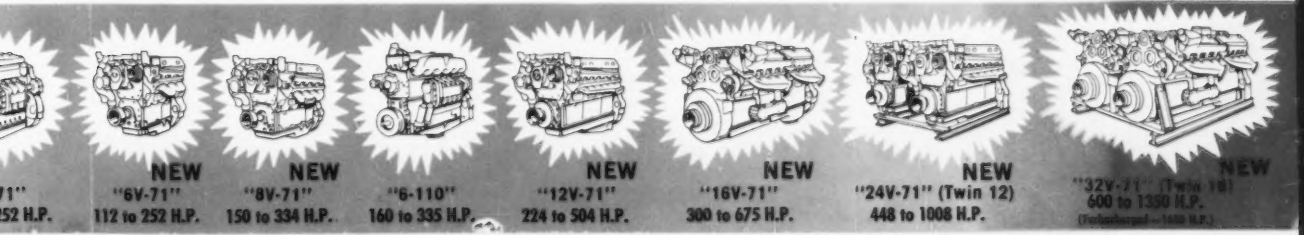
Production has started and complete programming has been established on all new engines. Non-turbocharged engines will be available first, followed later by Turbopower models to complete the power range.

So—now more than ever before, it pays to standardize on GM Diesel power. For whatever you want a Diesel to do, there's a GM Diesel to do it for you—faster, better, at less cost. Truly, here is a whole new concept in Diesel power—the All-Purpose Power Line. Get the full story by writing GM Diesel, Detroit 28, Michigan.

GM DIESEL

DETROIT DIESEL ENGINE DIVISION,
GENERAL MOTORS, DETROIT 28, MICH.

In Canada: GENERAL MOTORS DIESEL LIMITED, London, Ontario
Parts and Service Worldwide



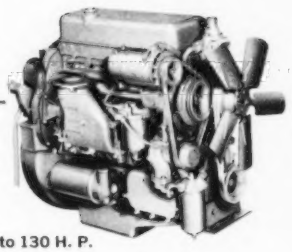
NOW...A "JIMMY" DIESEL for every power purpose

20 to 1650 H.P. in only 3 cylinder sizes

NEW SERIES 53

—smaller Diesels millions can use
2, 3, 4 and V6—20 to 195 H. P.

A scaled-down version of the famous Series 71 GM 2-cycle Diesel—identical in design principles—the new 53 Series incorporates the time-proved features of patented GM unit fuel injection and uniflow blower scavenging in more compact, lightweight units. These spacesaving engines open up whole new fields of Diesel usefulness in trucks, buses, and taxicabs, in marine service, as well as in tractors, generators, loaders, lift-trucks and many other types of industrial equipment.

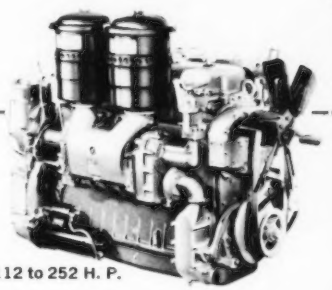


"4-53"—51 to 130 H. P.

SERIES 71 "IN-LINE"

—the versatile, time-proved economy Diesel
2, 3, 4, 6, Twin 4, Twin 6, Quad 6—33 to 1008 H. P.

Never, in industrial history, have there been Diesels as versatile and capable as the Series 71 GM Diesels—built in a wide range of Fan-to-Flywheel, Package Power, Torque Converter, Generator Sets, Economy truck engines and Turbopower models. And, because of GM Diesel's unique power concept—a family of engines featuring unequaled parts interchangeability—these time-proved "Jimmy" Diesels become even more valuable as key components of the GM Diesel All-Purpose Power Line. Today's "71" engines incorporate the results of 20 years' continuous improvement.



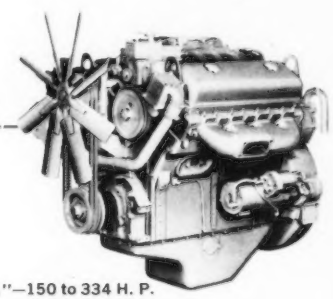
"6-71"—112 to 252 H. P.

NEW "V-71"

—higher horsepower in smaller, more compact units
V6, V8, V12, V16, Twin V12, Twin V16—112 to 1650* H. P.

The new V-71 "Jimmy" Diesels are a further dramatic illustration of GM Diesel's mighty new power concept—rounding out the All-Purpose Power Line—yet retaining the GM family relationship and parts interchangeability. Here are engines destined to give you a better investment-earnings ratio than any you have ever had before. Diesels that boast the ultimate in compactness, light weight, high efficiency, durability, inexpensive maintenance and parts interchangeability.

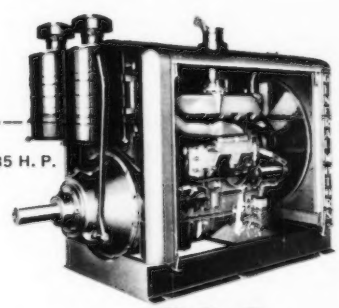
*Turbopowered



"8V-71"—150 to 334 H. P.

SERIES 110

—a favorite on heavy-duty jobs
6-110 and Twin-6-110—160 to 670 H. P.



"6-110"—160 to 335 H. P.

Renowned for its ability to get big jobs done faster at lower cost, the GM "6-110" has stepped in and taken over thousands of jobs for every kind of business—done those jobs as never before—greatly expanded the usefulness of Diesel power. Built in single- and multiple-engine units, the Series 110 engine is available for a wide variety of heavy-duty applications in earth-moving, oil-field, railroad and marine equipment.

GM Diesel
Detroit 28, Michigan
Send me detailed information on new GM Diesel All-Purpose Power Line. I am interested in new Series 53 (.....), Series 71 "in-line" (.....), new V-71's (.....), Series 110 (.....).

NAME ..... TITLE .....

COMPANY .....

STREET ADDRESS .....

CITY ..... ZONE ..... STATE .....

In Canada: GENERAL MOTORS DIESEL LIMITED, London, Ontario

GM DIESEL

DETROIT DIESEL ENGINE DIVISION,
GENERAL MOTORS, DETROIT 28, MICH.

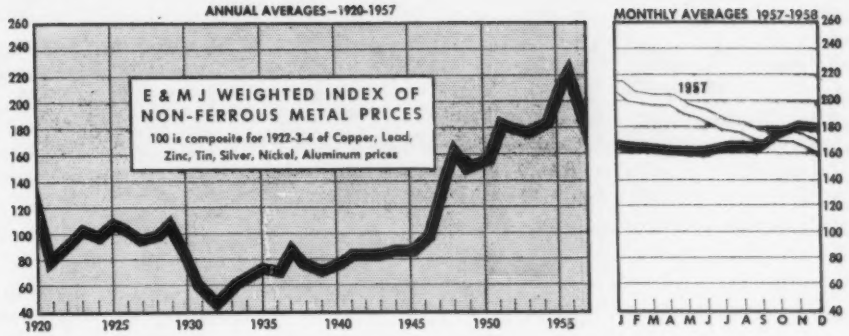
In Canada: GENERAL MOTORS DIESEL LIMITED, London, Ontario
Parts and Service Worldwide

Specifications subject to change without notice.

Litho U.S.A.

E&MJ OUTLOOK

PRICES



MARKETS

E&MJ's metal price index changed slightly from 184.05 for November to 183.96 for December.

●

AT HOME

Year-end forecasts by industry leaders reflect a healthy outlook for 1959. Here are some examples:

"The American steel industry, rapidly recovering from the third post-war recession, has prospects of reaching an operating rate of about 80% of present capacity during the first six months of 1959—an increase of approximately 45% over sharply curtailed operations in the first half of 1958."—Roger M. Blough, chairman of the board, United States Steel Corp.

"The estimated number of retail sales of passenger cars in 1958 is approximately 4.6-million, including imported cars. We at Chrysler believe that in 1959 the total will be in the neighborhood of 5.5-million. And with the right combination of market factors it could go as high as 6-million, including about 400,000 imported cars."—L. L. Colbert, president, Chrysler Corp.

"Stainless steel producers look to 1959 as a banner year. Preliminary fourth quarter figures indicate stainless has emerged from the recession doldrums, and encourage the prediction that 1959 output will substantially exceed 1958 tonnage." —American Iron and Steel Institute.

"The consensus was that the Gross National Product for the U.S. would be an annual rate of between $470 and 480-billion by the end of 1959, compared with a rate of about $450-billion currently."—Economic Forum of National Industrial Conference Board.

●

LABOR

International Union of Mine Mill and Smelter Workers plan to press for improvements in mine safety legislation, stockpiling of metals, higher tariffs on foreign metals and quotas limiting metal importation.

A new three-year contract effective Jan. 2, 1959, between International Nickel Co., and the Mine Mill and Smelter Workers provides for a 2.2¢ per hour wage increase in January 1959; an additional 4.4¢ on Jan. 2, 1960, and an additional 6.6¢ on Jan. 2, 1961. Fringe benefits granted total approximately ½¢ per hour.

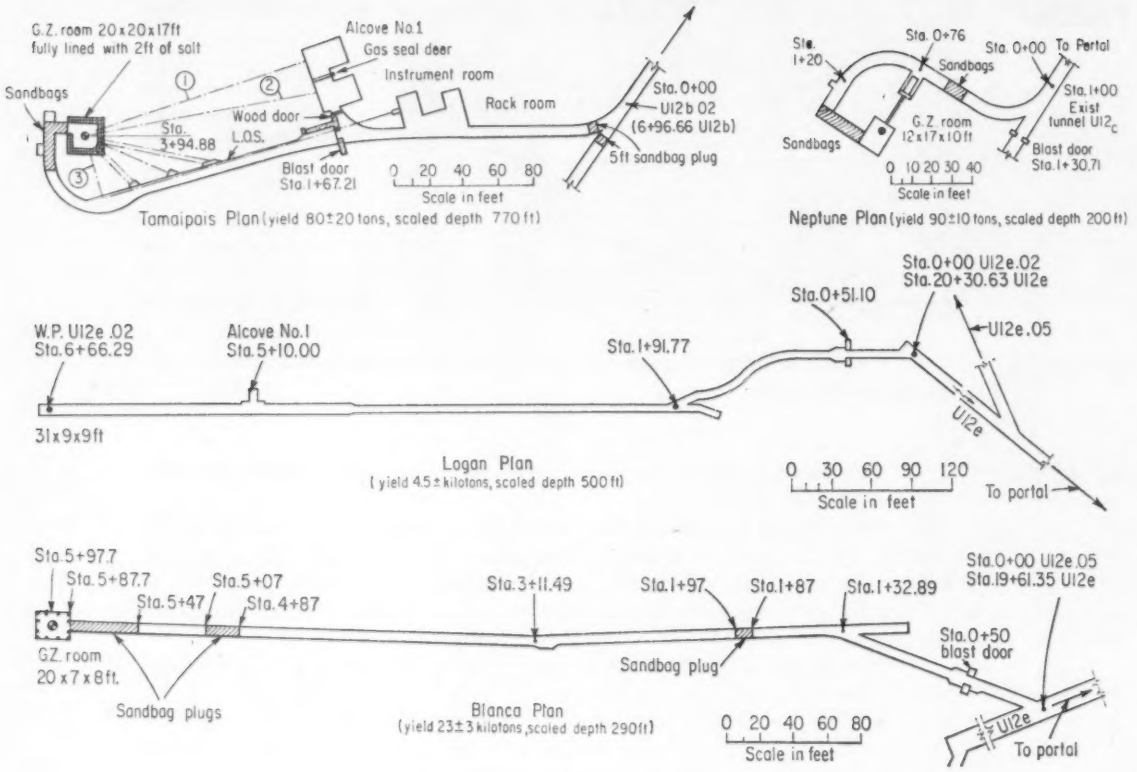
●

ABROAD

Australasian Oil Exploration, Ltd., has begun drilling on extensive uranium deposits at Anderson's Lode, in north Queensland.

Panther International Mining Co., Ltd. has scheduled a 10,000-ft exploration diamond drilling program on the Mystery Moak nickel belt in Northern Manitoba.

Cerro de Pasco Corp. plans to increase capacity of refined lead production to a level of 100,000 tons per year by the early 1960's according to an address by Robert Koenig, president before the New York Society of Security Analysts.

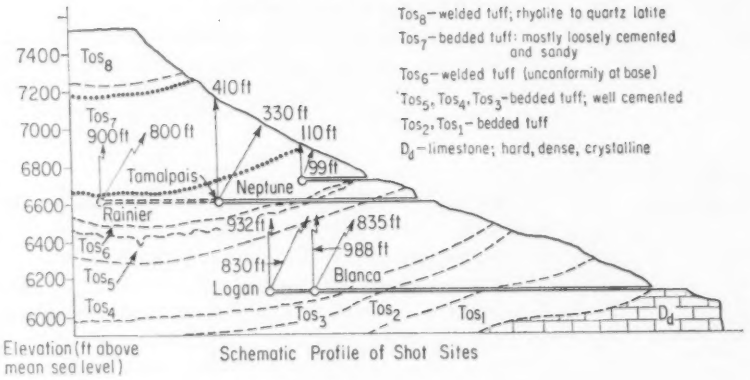


October Nuclear Blasts Bring Civil Uses Closer

FOUR UNDERGROUND NUCLEAR EXPLOSIONS, designed to develop data for civil applications, were fired by the Atomic Energy Commission during October 1958 at the Nevada Test Site. They were part of the "Plowshare" program, aimed at harnessing the explosive power of both fission and fusion reactions.

The program began in September 1957 with the "Rainier" test (see E&MJ April 1958 p. 21 and October 1958 p. 110) which proved that in silicate rocks (tuff) the radio-activity is limited to a small amount of insoluble fused material that can be handled easily. The program includes next summer's "Gnome" experiment on generating electricity from the resultant heat-pocket produced in rock-salt near Carlsbad, N.M. For 1960, a harbor excavation on the northwest coast of Alaska is planned. A possible Canadian plan involves using the heat to release oil from Alberta tar sands.

Pending more complete evaluation reports, due in two or three months when drillhole data are available, E&MJ's account of the shots is based on descriptions prepared by Dr. Gerald W. Johnson, test division leader, Lawrence Radiation Laboratory, University of California, Livermore, Calif. The illustrations give most of the general information.



Tamalpais, the first of the new shots, took place in a room lined with salt to give preliminary data for the forthcoming "Gnome" shot. Its yield (equivalent to 80 tons of TNT) was only a twentieth of Rainier's (equivalent to 1,700 tons of TNT). Although it was only 330 ft from a free surface as against Rainier's 800 ft., on a scaled depth it was 770 ft to Rainier's 670 ft. (Note: Scaled depth, useful for comparisons since linear dimensions of a spherical explosion's crater generally vary as the cube root of the charge weight, is depth divided by the cube root of the kiloton yield, in this case.)

Upon detonation, there was visible surface shock to the mesa slope which loosened some boulders. Although the tunnel collapsed near the blast, the steel-set supported instrument-alcove at 140 ft radial remained intact and there was no damage beyond. At 144 ft the blast door designed for 75 psi static load also remained intact. However, some rare gas fission product and con-

siderable CO and H_2 leaked into the tunnel. The concentration of hydrocarbon gases was explosive. They could have been produced by the large amount of wood, cable insulation and paraffin in the shot chamber. The leak probably was through highly fractured but unmelted rock close to the shot chamber into adjoining drifts for other shots, and possibly through an 8-in. pipe (2 in plan) or an 8-in. drillhole (3 in plan).

Neptune, at only 99 ft from surface, produced a crater about 200x150 ft in area and 30 ft deep—throwing an estimated 21,000 tons of rock down slope. There was some venting of radioactive material (under 2%) but very little surface contamination. Radiation levels after 5 days were less than 100 mr/hr except for a 1 r/hr area of 40x80 ft where a jet came out. (Note: AEC considers it safe to be exposed to 300 mr per week for unlimited time.) Only a small amount of spalling occurred in a tunnel at 165 ft radial from the shot point.

Logan, over 2½ times the yield of Rainier, was detonated at the end of a straight tunnel. This probably was aimed at giving data on possible distribution of the energy along tunnels, flat rooms or other openings in order to break larger volumes of rock than by a simple spherical distribution. Debris was completely contained. Ground shock was felt at 2½ miles but not at 7 miles, although one person in an upper bunk at 20 miles reported some motion. The main tunnel collapsed at a radial distance of 820 ft and at 700 ft radial the branch drift for a later shot ("Blanca") had considerable roof-fall and a floor rise. At 1,500 ft radial there was a 2½-ft thrust along a bedding plane. The blower and instrument shelters near the portal at 2,700 ft radial were undamaged.

Blanca gave more than ten times the yield of Rainier. Its shock kicked up soil on the slopes and broke loose a large quantity of cap rock that fell down the mesa sides. About 20 seconds after the shock reached the surface, a plume of dust was ejected as the cavity caved to the surface. The dust rose about 1,000 ft and carried radioactivity but probably less than 0.1% of the total. Ground shock rocked autos violently at 2 miles, was felt strongly at 5 miles and was noticeable as a rolling effect at 16 miles but not at 20 miles. There was a very small amount of radioactivity in the tunnel but normal work was possible. As with Logan, the tunnel collapsed at about 850 ft. There was a 3-ft thrust on a bedding plane at 1,500 ft, a 1-ft vertical movement on a fault at 2,200 ft but no damage to portal installations at 2,700 ft.

The ability to emplace such tremendous energies in such small openings can well revolutionize mining. It is believed that all shots have been fission type, so far.

As We Went to Press . . .

Despite "strong pressure" from a number of residents of Michigan's Upper Peninsula, Bear Creek Mining Co.'s request for a lease in Porcupine State Park will be turned down by the State Conservation Commission. The commission chairman, who heard residents ask for lease granting as a help to depressed employment in the area, and also heard leading conservationists oppose the grant, has recommended refusal by the Commission.

The possibility of an eventual disposal of at least some metal-mineral stockpiles has been raised officially for the first time. Government stockpile managers threw a pre-Christmas scare into the industry and then spent the holidays reassuring the trade that policy is firmly against unloading surplus which might cause disruptions in the market.

A "multi-million dollar program" will double production capacity at Humboldt Mining Co., on Michigan's Upper Peninsula to 640,000 tons of pellets annually. The jointly-owned (50-50) Cleveland Cliffs and Ford Motor Co. development could lead to opening of 200-million tons of low grade iron ore in the area owned by Ford. Reserves at Humboldt could yield 15-million tons of pellets.

Pickands, Mather has announced construction of a 42-mile railway connecting the Wabush Lake deposit in Quebec with the railway which connects Seven Islands and Knob Lake. The new line will represent the first step in the opening of the Wabush Iron, Ltd. orebody, leased from Canadian Javelin, which is said to run to 1-billion tons of beneficiable low-grade ore. Other stockholders of Wabush include Youngstown Sheet & Tube, Interlake Iron Corp., and Steel Company of Canada.

Bunker Hill Co. has purchased the Jack Pine phosphate lease in the Elliston, Mont. field, about 30 miles from Helena. The rock will be feed for Bunker Hill's new fertilizer plant.

One of the major cutbacks of AEC service to industry will be the closure of the Monticello mill, now expected "to be effected some time in the middle of 1959."

Mining Calendar

Mining Symposium & Minnesota AIME Annual Meeting, Duluth, Minn., Jan. 12 to 14.
Themes: Russian Iron Industry from Mine to Steel Mill; Instrumentation and Controls in Mining and Beneficiation.

Tenth Plant Maintenance & Engineering Show, Public Auditorium, Cleveland, O., Jan. 26 to 29.

Ninth annual Governor's Industrial Safety Conference, Biltmore Hotel, Los Angeles, Calif., Feb. 5 and 6.

Centennial Celebration & Mining Convention, Colorado Mining Association, Denver, Feb. 5 to 7.

AIME annual meeting (San Francisco), St. Francis, Sheraton Palace and Sir Francis Drake Hotels, San Francisco, Calif., Feb. 15 to 19.

Symposium, "The Application of the FluoSolids Reactor to the Mineral Industry," Univ. of Ariz., Tuscon, Feb. 23 to Mar. 3.

Twenty-first American Power Conference, Illinois Institute of Technology, Hotel Sherman, Chicago, Ill., Mar. 31 to Apr. 2.

Canadian Institute of Mining and Metallurgy annual meeting. Queen Elizabeth Hotel, Montreal, Quebec, Apr. 13 to 15.

Third Symposium on Rock Mechanics, Colorado School of Mines, Golden, Colo., April 20 to 22.

International Symposium, Physical Chemistry of Extractive Metallurgy, Pittsburgh, Pa., April 27, 1959.

WASHINGTON IMPACT

Highlights

NEW YEAR'S IRRESOLUTIONS—For most businessmen, Washington's 1959 record of Government policymaking will seem anticlimactic in comparison with even last year's scorecard of compromise. The art of decision-making promises dubiously to be one of reaction rather than action, depending almost entirely on the special circumstances surrounding each domestic and foreign problem as it comes up.

There are few generalizations that can be made safely, and those that appear sufficiently vague to be certain do not necessarily apply to the metal-mineral industries (see *E&MJ*, November & December 1958, p 20).

FEDERAL PURSESTRINGS—New Democratic majorities in the Senate and House are sure the November election was a mandate to continue the rate of Government spending. This means a bigger budget than the one President Eisenhower will submit to Congress this month, but there will be few if any new outlays for mining. At best, the willingness of the new Congress to shell out Treasury funds may hold out a slim hope for new metal-mineral subsidies on a case-by-case basis—but then only if domestic firms suffer new economic setbacks, such as the loss of protection from import competition lead-zinc mines would face if the recent domestic quotas are challenged in court.

UBIQUITOUS TAXES—One woe the mining industries can share with almost every segment of the business world is the prospect of continued high taxes. A steady rate of spending—contrary to some economists' hopes—has many influential Congressmen convinced not only that present tax rates must be kept, but also that eventually they must be hiked to make up deficits in the budget. This virtually rules out any chance for tax let-ups, except in special cases of small businesses. For example: U.S. investors overseas may also get some tax benefits.

GOVERNMENT REGULATION—Again, the new Congressional Democratic weight hints more committee investigations of Executive regulator agency performance, charges of business influence on the GOP Administration, antitrust policing and the like. But here also, the metal-mineral industries fall outside the practical application of what's in store for other businessmen. Mining industry strength in Washington was not lessened by the general elections; in fact it may have scored new gains. In the antitrust field, for example, while trust-busting liberals can be counted on to bring new pressures on automobile makers and others, they are still in favor of international commodity controls to protect domestic producers from foreign competition.

About the only regulatory area in which the new Congress may make more rather than less trouble for some mining interests comes under the heading of Public Lands policy. Here, the new Democratic majority leans towards tougher conservation laws.

INTERNATIONAL POLICIES—On foreign affairs in general and foreign trade in particular, Congress and the Administration seem to see more eye-to-eye now than at any time in the last six years. No new trade legislation is in the works, and the only trade issue this year lies with the trade regulatory agencies—Tariff Commission, OCDM, Treasury Department's Customs Bureau, etc.

Congress will, of course, continue to watchdog administration of new loopholes in the trade laws, but with mixed results. OCDM officials, at the same time they were cautioning domestic producers not to regard the broad new defense-essentiality clause as an invitation to more trade restrictions, just last month announced new defense-essentiality investigations of imports of cobalt, fluorspar, and tungsten. Escape clause petitions at Tariff Commission and anti-dumping petitions at Treasury are also on the rise.

Congressional watchdogging of trade regulation will be divided between the freer-trade and protectionist proponents, putting conflicting pressures on the Administration to walk a fine line of compromise. Lead-zinc won domestic import quotas, but an appeal for restrictions on alleged dumping of Belgian aluminum was recently rejected by Treasury.

Forecasts for 1959 Remain Optimistic

SOOTHSAYING SEASON is here again, as Government bureaus and private Washington economic analysts join industry executives in annual new year predictions for business—in general and in particular.

Forecasters' tunes are considerably cheerier this January than last, with sweet tones of an over-all economic pick-up replacing 1958's discordant strains of recession. But in some fields, sour notes are still being sounded.

Here, culled from both Government and private prognosticators' reports, are some of the key metal-mineral industry indications for the coming year:

Mining machinery—Commerce Department's Business and Defense Services Administration sees "a moderate pick-up" in output in 1959 over 1958, and a boost in sales of 15 to 20%. Most of this year's improvement, as well as last year's decline, is attributed to the general health of coal and steel production. With output of these commodities forecast for a solid rise, equipment sales follow naturally.

But there is more to the story. Capital improvement plans, Government economists feel, are steadier now than a year ago—more "serious in intent." Also, continued improvement in nonferrous markets for copper, lead and zinc will spur both new sales of equipment and replacement buying. Government activities in the field of exploration and development research aids may provide an added impetus.

Lead and zinc prices—a private economic research group's study of nonferrous markets in 1959 is bullish. Lionel D. Edie & Co. reaches the simple conclusion: "A continued recovery in business activity, which is expected for 1959, will mean higher nonferrous metal prices than at present."

An historic study of rises in industrial production and Gross National Product in the post-recession years 1938, 1950 and 1955, leads this report to the assumption of a direct correlation between these indicators and nonferrous prices.

The study makes no flat predictions as to how high prices may go, but forecasts a steady and substantial boost.

As for lead-zinc demand, according to BDSA, 1959 lead consumption will rise about 5% over the 1958 estimated 1-million short tons, zinc slabs 8 to 10% over last year's 865,000 short ton figure.

Automobile production increases, with resulting boosts in demand for batteries, will hike lead consumption, predicts BDSA, and autos, steel and brass mill output increases will do the same for zinc.

Ferroalloys—closely tied also to a resurgent steel industry, production and shipments this year will shoot 25% above 1958. Imports and exports will drop.

Iron ore—in a brief reference, BDSA predicts a larger boost for exports of iron ore this year than the expected rise in imports.

Copper—increased demand late last year, and indications it will continue growing this year, is "the most favorable factor on the horizon," says BDSA. The agency avoids percentage predictions, but sees housing starts, auto production, durable goods markets, capital expenditures, and inventory replenishing as factors which will continue to pull copper demand upward.

Aluminum—shipments up 20% this year, predicts BDSA. The outlook for aluminum is "exceptionally promising," as autos, housing starts, highways, and consumer goods eat up more and more aluminum.

Magnesium—last year's upward trend will continue, BDSA says, and grow at a faster rate than general business. Consumption by the military as new civilian markets may boost shipments 20 to 25% over 1958. But production won't follow suit, because of swollen inventories.

Columbium-tantalum—again BDSA is bullish. New defense needs will boost tantalum production, and columbium is already experiencing a steady growth in output and demand.

Scrap Dealers Seek Aid

THE INSTITUTE of Scrap Iron & Steel (ISIS) has laid its industry's market problems on the line in Washington as part of a new campaign to win Government support for slipping sales.

The trade groups turned first to the Office of Civil and Defense Mobilization, where Myron Chase, of Luria Bros., the president of the Institute, talked informally with agency officials to explore what—if anything—can be done to throw Government backing behind stepped-up scrap consumption in the U.S. and overseas.

But the campaign may go beyond OCDM. ISIS is not formally appealing for any of three steps the mobilization agency traditionally has taken to aid domestic producers: Curbs on competing imports on grounds of an industry's defense essentiality; stockpiling or incentive purchases of domestic output; or fast tax amortization benefits for new production.

In fact, only one of these measures—defense essentiality curbs on competing imports—is still being used. Stockpiling and tax write-off programs are all but dead, although specific programs already on the books are being allowed to run out gradually.

Best bet is a drive for curb on competing imports of iron ore. In this campaign, ISIS is already assured of a strange bed-fellow, the domestic iron ore mining industry that competes with scrap ordinarily for sales in the home market. Iron ore miners in the Great Lakes Region have been complaining about foreign iron ore imports for some months, and are largely responsible for the current Tariff Commission investigation of their own slipping sales and shipments.

Labor This Month

1959—THE GAMBLE OF ORGANIZED LABOR: The new year is turning the practical labor leader into a bettor of sizeable proportions. It is a year that can go either way for him. His legislative goals may come through; his bargaining demands may be met by management. But, while the odds lean in labor's favor for 1959; it's still a gamble that can be lost. It can, before it's over, be a setback for labor. But still, union officials aren't going to make a wary approach. They're going-for-broke in the Congress on the two issues that really count—legislation and bargaining.

Here's the outlook:

The new 86th Congress is bending a sympathetic ear to union demands—up to a point. Where the issues don't trammel too much on political toes, the Congress seems likely to write some unusual labor laws. But, where the old chestnuts—such as Taft-Hartley— are put back in the legislative fire, Congress still won't touch. The following list contains the likeliest key union demands on Congress, and the prospects for success or failure:

- **Reform legislation.** Labor officials are pulling hard for an anti-racketeering bill, much like the Kennedy-Ives measure that failed to pass Congress last session. The complaint that it was "too moderate" brought its defeat. Though it's unlikely to be tightened this time, the liberal majority will probably see labor's way. The unions want this bill to wrap up their racketeering troubles.
- **Taft-Hartley.** Labor will make a noisy pitch this way—write in a ban on state right-to-work laws, ease boycott curbs, allow economic strikers to vote in representation elections. Congress won't open the T-H doors wide. The latter demand might squeak through, nothing else.
- **Unemployment.** Here, unions will pressure on several fronts. They demand Federal minimums for State Unemployment Compensation rates; they want Federal aid to chronically depressed areas. There's a chance on this, depending on the White House. Labor Secretary Mitchell may press for Federal jobless pay rates. If President Eisenhower goes along, Congress may too. Otherwise, no.
- **A $1.25 minimum wage,** extension of coverage to retail trades, other groups. The latter may work, but no hike is foreseen in the current $1 minimum.
- **Other issues.** Unions have their particular legislative interests. The Mine-Mill and Smelter Workers, for instance, will concentrate on mine safety legislation, a metals stockpiling bill, higher tariffs on foreign metals and quotas limiting metal importation.

BARGAINING FOR 1959 is much less certain, and much more touchy for labor. The unions are readying some extensive demands. And they're coming in the face of serious trouble signs. The warnings showed up through late 1958—surprise strikes broke out in the newspaper industry, airlines, farm equipment. And where the unions got tougher, management fired back. New alliances of employers were formed; six airlines pledged extra strike revenues to the airline being struck. New York publishers closed down their papers when one was hit by a walkout. These are the initial marks of strife. Where it breaks out in 1959 is anybody's guess, at this point. But these are the key negotiations to watch:

- The steel industry-United Steelworkers negotiations. Three-year contracts run out in June. UAW leaders talk a hefty wage demand, will also concentrate on share-the-work to ease unemployment. This may well be the place for the first serious shorter workweek bid in a major industry. Both sides freely predict trouble to come in the next 12 months.
- Nonferrous mining—Mine-Mill and Smelter Workers. The deadline matches steel, the concern over unemployment does too. Steel's bargaining fate may well extend to nonferrous mining.
- Railroad bargaining—A big one after three years. Always complicated, this looks like a long tangle. Especially, when bargaining atmosphere isn't good.
- Other big negotiations in 1959; aluminum, fabricated metals products, rubber and meatpacking.

MARKETS

Aluminum Firms Cut Output; Copper Prices Down in Europe; Zinc Firm

AVERAGE PRICE of nonferrous metals in December was unchanged compared with November.

Copper prices outside the U. S. fell sharply in December—the *E&MJ* average was 27.041c f.o.b. U. S. refinery and in November it was 29.476c per lb. London prompt was down £20, about 2½c and London three months was down about 2c. For much of December some U. S. custom smelters were at 28½c delivered, though before the end of the month all were at 29c, the price the U. S. producers have maintained. Katanga dropped to 27.9c Dec. 9; it raised to 28.125c Dec. 22.

The fall in prices outside the U. S. was largely a corrective action started the previous month. They had risen above the U. S. 29c price by as much as 3½c, reflecting the strike situation but also the expectation the U. S. producers would raise their prices. The U. S. producer price is the stable price in world copper markets and when it did not rise and the strikes were settled, other prices worked toward a reasonable relationship with it. Since the U. S. has a 1.7c import duty, and except in times of fairly sharp recession must be a net importer of copper, prices in the U. S. are likely to be higher than in other areas. When there is a real or anticipated shortage this relationship may be reversed. As a shortage becomes doubtful a "normal" comparative price situation develops. This has been happening the past month or two.

Refined copper stocks held by producers in the Free World dropped in November by 32,880 short tons according to the Copper Institute. In the three months September—November they dropped 198,954 tons. In this period blister stocks rose 52,693 tons. Though some of the drop reflected replenishment of "pipelines" it was generally agreed much of it was needed in the pick-up in industrial activity.

U. S. fabricators in November shipped 110,487 tons of copper products, considerably more than for many months of 1958. It was about 28,000 tons under October when their customers bought heavily owing to the better business outlook and expectation of higher copper product prices.

The amount of copper priced in the U. S. in December reported to *E&MJ* for calculating average prices was little changed from November but well above most earlier months. Copper reported from outside the U. S. was down slightly and even more compared with earlier months.

The battle of the aluminum companies was more obvious in December. In part this stems from the sharp increases in primary capacity with further capacity, planned before recent and current market uncertainties were apparent, to be brought in in 1959 and later. Primary sales by U. S. producers in 1958 were about equal to output, 1,550,000 tons. Of this about 300,000, possibly 340,000, from the three major producers went to the stockpile. In 1959 only about 38,000 tons are eligible for the stockpile. And some, possibly all, of the new production will need to find a consumer market. President F. L. Magee of Alcoa said consumer shipments will increase by more than 10%; unless large foreign markets are taken from other firms it will probably need to jump by more than 20% to offset the stockpile decrease alone.

Alcan announced it was cutting output 10% to 500,000 tons per year. Major U. S. integrated producers are taking less from her; Alcan will need to depend more on the independent fabricator. Also, U. S. firms are buying controlling interests in former independents and displacing Alcan metal (Reynolds even bought a Canadian independent and early in the year obtained 50% control of Tube Investments, a large fabricator in the U.K.). Alcoa stopped output at one potline in Tennessee indicating that it was not economical to operate it during the present water shortage when power costs are high. There are also rumors of labor trouble.

Alcan's parent company announced it was expanding the capacity of its U.K. Rogerstone plant, owned by Northern Aluminum, to 75,000 tons from 50,000. It said Northern has about 35% of U.K. mill capacity and that provisions for an additional 100,000 tons are being considered. With loss of independent and other markets for primary, Alcan may have to become more integrated.

Harvey Aluminum has been producing primary metal about two months.

Few analysts expect the aluminum struggle to take the form of sharper price competition in primary metal, though discounts on products could become greater.

Lead prices were considered steady in the U. S. at year end but they had dropped about ¾c in London during the month. American Bureau of Metal Statistics for November showed U. S. stocks up about 10,000 tons from the previous two months and excessively high relative to shipments. Sales reported to *E&MJ* for calculating the average price were lower than in November and much lower than in October. Many observers believe the U. S. import quotas will permit maintenance of the present 4c "premium" over London prices.

Prime Western zinc prices in the U. S. are firm. London is now about ⅛c above the opening of the month. U. S. smelter zinc stocks dropped about 18,500 tons in November. Sales reported to *E&MJ* for calculating weighted average prices were down from the exceptionally high amounts for the previous three months and close to the earlier months.

Improvement In E&MJ Copper Averages

CURRENTLY the two *E&MJ* weighted average copper quotations include the following:

1) The U.S. domestic refinery quotation includes only copper that is both mined (or refined from scrap) and sold for consumption in the U.S.

2) The export (or foreign) refinery quotation includes:

a) copper originating outside the U.S. and sold for consumption in the U.S.

b) copper originating outside the U.S. and sold for consumption outside the U.S.

c) copper of U.S. origin sold for consumption outside the U.S.

Many officials of copper firms believe these quotations measure no clearly definable entities. They suggest that 2)a) above be transferred from the export quotation to the U.S. domestic refinery quotation. At present copper imported from Chile and other areas outside the U.S. and sold at 29c (or any other price) is included in the export quotation with the U.S. 1.7c import duty included. The domestic quotation would include the duty also.

The proposal that all copper sold in the U.S. market be included in the U.S. domestic quotation and that all copper sold outside the U.S. be included in the other quotation has received almost unanimous support. (Requests for comments on this proposal were first made in the Aug. 29, 1957 issue of *E&MJ Metal and Mineral Markets*, p. 9) This change in procdure will have almost no effect on the current quotation because not much copper is now being imported into the U.S. for consumption in the U.S. For a number of months the U.S. was a net exporter of copper.

Additional Quotation

Some factors have suggested that a foreign copper quotation reduced to an f.o.b. U.S. refinery basis is confusing. They maintain that a foreign quotation would be more useful and conform more to prices actually involved in trade if the quotation were on a c.i.f. main European ports basis.

Though making a change of this sort would only be a formal rather than real change, *Engineering and Mining Journal* and *E&MJ Metal and Mineral Markets* believe the present quotation needs to be continued. For those firms interested in the quotation on the c.i.f. European basis we plan to add the ocean freight and insurance and publish the weekly, monthly and annual foreign quotations in this form as well as in the present form.

These changes are the result of extensive correspondence in the past year and a half with officials of many firms doing various kinds of copper business. Agreement is now almost unanimous. Further comments are invited. Since changes made at other than the first business day of the year could cause difficult problems it is proposed to introduce the improvements Jan. 2, 1959.

Average Prices December *(E&MJ Quotations)*

Copper:
Electrolytic, domestic refinery .. 28.583
Electrolytic, export refinery ... 27.041
Lead:
Common, New York 13.000
Common, St. Louis 12.800
Silver and sterling exchange:
Silver, New York, per oz. 89.935
Silver, London, pence per oz. ... 76.167
Sterling Exchange 280.380
Zinc:
Prime, Western, East St. Louis .. 11.500
Prime, Western, delivered (g) .. 12.000
Tin:
New York Straits 98.976
Gold, per oz., U. S. price $35.000
Quicksilver, per flask 220.182
Antimony (E&MJ) (d) 32.590
Antimony, bulk, Laredo 29.000
Antimony, in cases, Laredo .. 29.500
Platinum, refined, per oz. $52.000
Cadmium (a) 145.000
Cadmium (b) 145.000
Cadmium (c) 145.000
Aluminum, 99% plus ingot ... 26.800
Magnesium, ingot 35.250
Nickel (f) 74.000

Domestic quotations, unless otherwise stated, are in cents per pound. Sterling exchange checks, in cents. Quicksilver, per flask of 76 lb.
(a) Cadmium average based on the producers' quotations.
(b) Cadmium average based on the average of the producers' and platers' quotations.
(c) Cadmium average based on platers' quotation.
(d) Domestic 5 tons or more but less than carload lots, packed in case f.o.b. New York.
(f) Contract price, f.o.b. Port Colborne U.S. duty included.
(g) Delivered where freight exceeds 0.5c.

"Free" Gold Market

Volume of international gold trading increased 32.6% in 1958, reaching a record high. Bar gold prices fluctuated fractionally but rose 10% in Djakarta and lost 8% in Warsaw during the year. Coin prices were about 3% lower. Private U. S. gold hoarding purchases showed an uptrend. Freedom of gold ownership was extended in some countries. Soviet gold sales were small. A principal event of 1958 was the constant outflow of gold from the U. S. which totaled almost $2.3-billion. Pick's World Currency Report quotes on "free gold" per fine oz as follows:

	COINS		BARS (12.5 kg)	
	Nov. 30	Dec. 31	Nov. 30	Dec. 31
NEW YORK transit	.....	.....	$35.08⅛	$35.08⅛
MANILA	$42.25	$42.25	36.00	36.15
HONG KONG	46.45	45.80	38.60	38.45
BOMBAY	61.00	58.50	56.50	56.50
TANGIER	39.90	40.60	35.20	35.20
BEIRUT	42.00	40.75	35.23	35.23
PARIS	40.45	40.75	36.00	35.75
BUENOS AIRES	38.70	38.00	35.15	37.40

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

Custom Smelter Copper Price

Based on flat price and E&MJ-average price sales in U. S. for month of December reported by American Smelting & Refining Co.: electrolytic copper in standard shapes, adjusted to nearest ⅜c; ¼c deducted for selling common.

Delivered Consumers' plant 28.750 lb
F.o.b. refinery ..... 28.350 lb

Major Metals

U. S. DAILY AND AVERAGE PRICES

Dec. 1958	Electrolytic Copper (a) Domestic	Electrolytic Copper (b) Export	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Primary Pig 99%	Straits Tin New York
1	28.600	28.000	13.000	12.800	12.000	11.500	24.700	99.125
2	28.600	27.650	13.000	12.800	12.000	11.500	24.700	99.125
3	28.575	27.100	13.000	12.800	12.000	11.500	24.700	99.000
4	28.550	27.200	13.000	12.800	12.000	11.500	24.700	98.875
5	28.575	26.925	13.000	12.800	12.000	11.500	24.700	99.125
8	28.575	27.150	13.000	12.800	12.000	11.500	24.700	99.125
9	28.500	26.825	13.000	12.800	12.000	11.500	24.700	99.250
10	28.550	26.525	13.000	12.800	12.000	11.500	24.700	99.125
11	28.600	26.825	13.000	12.800	12.000	11.500	24.700	99.125
12	28.550	27.025	13.000	12.800	12.000	11.500	24.700	99.000
15	28.600	26.875	13.000	12.800	12.000	11.500	24.700	99.000
16	28.600	26.875	13.000	12.800	12.000	11.500	24.700	99.000
17	28.600	26.575	13.000	12.800	12.000	11.500	24.700	98.875
18	28.550	26.950	13.000	12.800	12.000	11.500	24.700	99.000
19	28.600	26.975	13.000	12.800	12.000	11.500	24.700	99.000
22	28.600	26.950	13.000	12.800	12.000	11.500	24.700	99.000
23	28.600	26.975	13.000	12.800	12.000	11.500	24.700	99.000
24	28.600	27.025	13.000	12.800	12.000	11.500	24.700	99.000
25				—Holiday—				
26	28.600	27.150	13.000	12.800	12.000	11.500	24.700	No Market
29	28.600	27.150	13.000	12.800	12.000	11.500	24.700	98.750
30	28.600	27.200	13.000	12.800	12.000	11.500	24.700	98.625
31	28.600	26.975	13.000	12.800	12.000	11.500	24.700	98.375
AVERAGES FOR MONTH								
Dec.	28.583	27.041	13.000	12.800	12.000	11.500	24.700	98.976
AVERAGES FOR WEEK								
Dec.								
3	28.594	27.545	13.000	12.800	12.000	11.500	24.700	99.156
10	28.550	26.925	13.000	12.800	12.000	11.500	24.700	99.100
17	28.590	26.835	13.000	12.800	12.000	11.500	24.700	99.000
24	28.590	26.975	13.000	12.800	12.000	11.500	24.700	99.000
31	28.600	27.119	13.000	12.800	12.000	11.500	24.700	98.583
CALENDAR WEEK AVERAGES								
Dec.								
5	28.580	27.375	13.000	12.800	12.000	11.500	24.700	99.050
12	28.555	26.870	13.000	12.800	12.000	11.500	24.700	99.125
19	28.590	26.850	13.000	12.800	12.000	11.500	24.700	98.975
26	28.600	27.025	13.000	12.800	12.000	11.500	24.700	99.000

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Dec. 1958	Silver (c) New York	Silver London	Sterling Exchange	Gold London	Gold (d) United States
1	90.125	76.750d.	280.4062	250s. 3¼d.	$35.00
2	90.125	76.750d.	280.3125	250s. 4¾d.	35.00
3	90.125	76.750d.	280.2812	250s. 5d.	35.00
4	90.125	76.750d.	280.3125	250s. 4½d.	35.00
5	90.125	76.750d.	280.2812	250s. 4¾d.	35.00
8	90.125	76.375d.	280.1875	250s. 5¼d.	35.00
9	90.125	76.375d.	280.2187	250s. 5¼d.	35.00
10	90.125	76.375d.	280.4062	250s. 5¼d.	35.00
11	89.875	76.125d.	280.4687	250s. 3¼d.	35.00
12	89.625	75.875d.	280.4687	250s. 3d.	35.00
15	89.625	75.875d.	280.5187	250s. 2¾d.	35.00
16	89.625	75.875d.	280.5312	250s. 3d.	35.00
17	89.875	75.875d.	280.5625	250s. 1¾d.	35.00
18	89.875	75.875d.	280.5000	250s. 2d.	35.00
19	89.875	75.875d.	280.4687	250s. 2¼d.	35.00
22	89.875	75.875d.	280.5000	250s. 2¼d.	35.00
23	89.875	75.875d.	280.4375	250s. 2¼d.	35.00
24	89.875	75.875d.	280.4687	250s. 2d.	35.00
25			—Holiday—		
26	No Market	Holiday	280.4812	Holiday	35.00
29	89.875	75.875d.	280.0781	250s. 5½d.	35.00
30	89.875	75.875d.	280.2500	250s. 3¾d.	35.00
31	89.875	75.875d.	280.2187	250s. 4d.	35.00
AVERAGES FOR MONTH					
Dec.	89.935	76.167d.	280.380	—	35.00
AVERAGES FOR WEEK					
Dec.					
3	90.125	—	280.359	—	35.00
10	90.125	—	280.281	—	35.00
17	89.725	—	280.510	—	35.00
24	89.875	—	280.475	—	35.00
31	89.875	—	280.257	—	35.00

Calendar Week Averages: New York Silver: Dec. 5, 90.125; 12, 89.975; 19, 89.875; 26, 89.875.
(e) No Market (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.400c per pound, the average differential for delivery charges.

(b) Our export quotations for copper reflect prices obtaining in the open market and are based on sales in the foreign market reduced to the f.ob. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.125c for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West, and West effective April 9, 1958, commanded a premium of 1c per pound over the current market for Prime Western; Special High Grade 1.25c effective April 9, 1958.

(f) Prime Western delivered where freight from E. St. Louis exceeds one-half cent.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 points (almost all U. S. lead is corroding grade).

(c) The daily silver quotation reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually one quarter cent below the price at which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5 per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

MARKETS (*Continued*)

London Metal Exchange Quotations

Dec.	COPPER Cash Bid	COPPER Cash Asked	COPPER 3 Mo. Bid	COPPER 3 Mo. Asked	LEAD Current Month Bid	LEAD Current Month Asked	LEAD 3 Mo. Bid	LEAD 3 Mo. Asked	ZINC Current Month Bid	ZINC Current Month Asked	ZINC 3 Mo. Bid	ZINC 3 Mo. Asked	TIN Cash Bid	TIN Cash Asked	TIN 3 Mo. Bid	TIN 3 Mo. Asked
1	227½	228	227½	227¾	74½	74¼	74¼	74½	74¾	75¼	72¼	72½	757½	758	760	761
2	225¾	226	225¾	226	73¼	73⅝	73¼	73½	73¼	73½	70¾	71	757½	758	760	761
3	219	219½	219½	220	71½	71⅝	71½	71⅝	72	72½	69½	69¾	754½	755	757	758
4	218¾	219	219¼	219½	71⅝	71⅝	71⅝	72	72½	72¼	69	69¼	753	753½	756	756½
5	219¾	220¼	220½	220¾	73	73¼	73⅛	73¼	73¾	74	70½	70¾	756	756½	759	759½
8	219¾	220	219¾	220	72⅝	72¾	73	73¼	73½	73¾	70¼	70⅝	757	757½	759½	760
9	215¾	216	215¾	216	70¾	71	71	71½	72¾	73¼	69½	70	758½	759	759	759½
10	219	219¼	219	219¼	71	71½	71¼	71⅝	72½	72¾	69½	69¾	761	761½	760½	761
11	221¾	222	221¼	221½	71⅝	71⅞	72	72½	73½	73¾	70½	70⅝	762	763	762	762½
12	222	222¼	221½	221¾	71⅝	71½	71½	71⅝	74	74¼	70¾	71	761	762	761	761½
15	218¼	218½	218	218¼	71¼	71⅝	71¼	71½	75	75¼	71	71¼	760	761	760	761
16	218¼	218½	217½	217¾	71⅝	71½	71⅝	71¾	75¼	75½	72	72½	758½	759	758½	759
17	220¼	220½	219	219¼	72⅝	72¾	72½	72⅝	76¼	76½	72½	72¾	757	757½	757½	758
18	220¼	220½	219½	219¾	72⅝	72½	72¼	72½	75	75¼	71¾	72	758½	759	759	759½
19	221	221¼	220¾	221	72⅝	72¾	72½	72⅝	74⅝	74½	71¼	71¾	756	756½	757½	758½
22	221	221¼	220¼	220½	72⅝	72½	72⅝	72⅝	74½	74¾	71⅝	71½	753½	754	755½	756
23	221¼	221½	221	221¼	71½	72	72	72½	74⅝	74½	71¼	71½	753	754	755	756
24	221¾	222	221¼	221¾	71¾	72	72	72¼	74½	74¾	71¾	72	753½	754	756	756½
25	Holiday															
26	Holiday															
29	223	223¼	222½	222¾	72¼	72⅜	72⅝	72½	75½	75¾	72¼	72½	753	754	756	757
30	223¾	224¼	223¾	224	73½	73⅝	73½	73¾	75¾	76	73¼	73½	750	751	753½	754
31	220	220¼	219¼	219½	71¾	71⅞	72	72⅛	75¾	76	72¾	73	747	749	749½	750½
Av'g's	£220.994		£220.732		£72.202		£72.327		£74.342		£71.253		£756.452		£758.060	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.97%, zinc 98% and tin min. 99.75%.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments, f.o.b. New York unless otherwise stated, tons of 2,000 lb. unless otherwise noted. St—short ton; lt—long ton. (p) duty paid.

MISCELLANEOUS METALS

December 31, 1958

Aluminum ingot, 99 plus % lb.			26.8¢
Antimony, spot, lb., less than carload, in cases			32.59¢
In bulk, carload lots, f.o.b. Laredo			29.00¢
Imported, 10 ton min. (p), 99½%			24¢
Bismuth, ton lots, lb.			$2.25
Cadmium, commercial sticks, delivered, lb.			$1.45
Calcium, lb., ton lots, 98%, cast			$2.05
Chromium, 97% grade, lb., contract del.			$1.29
Cobalt, 97 to 99%, per lb. eff. Feb. 1, 1957			$2.00
Germanium, per gram, 10,000 gram lots			(c)37¢ — (d)40.2¢
Indium, troy oz.	$1.25	@	$2.25
Lithium, lb., 98%	$9.00	@	$11.00
Nickel, cathodes, lb. (a)			74¢
Other sales, reg. sellers			74¢
Sales by dealers, etc.			74¢
Magnesium, 99.8% carloads, lb. producer's plants, Velasco, Texas eff. Apr. 16			35¼¢
Palladium, troy oz.	$15.00	@	$17.00
Platinum*(wholesale lots), troy oz.	$51	@	$55
Quicksilver, flask of 76 lb. 25 flasks or more	$218	@	$222
Selenium, 99 plus %, lb.—(Feb. 19, 1958)			$7.00
Silicon, minimum 97%, carloads, lb.			21½¢
Semi Conductor grade, lb.			$350
Tellurium, lb.			$1.65
Thallium, 100 lb. or more lb.			$7.50
Titanium, 99.3 plus, grade A-1, max. 3% iron, lb. (b)	$1.62	@	$1.82

(a) Eff. Dec. 6, 1956; incl. U. S. duty; (b) Effective Oct. 1, 1958. (c) Delivered; (d) f.o.b. plant.

METALLIC ORES

Beryllium Ore, imported, 10% BeO, per short ton unit	(a)$28	@	(a)$35
Chrome Ore per long ton, f.o.b. cars Atl. ports, dry:			
44% Cr_2O_3 no ratio	$22	@	$23
48% Cr_2O_3 3 to 1 ratio	(a)$42	@	$44
Iron Ore, Lake Superior, Lower Lake ports, long ton:			
Old Range bessemer			$11.85(e)
Mesabi bessemer			$11.60(e)
Mesabi, non bessemer			$11.45(e)
Lead (Galena), 80%, Joplin, Mo., ton			$156.12
Manganese Ore—Per long ton unit of Mn basis 48% manganese, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports import duty extra, $.915 @ $.965, Long-term contract nominal. Indian Gov't export duty discontinued Nov. 24, 1958.			
Molybdenum Ore, 90%, per lb. of Mo f.o.b. mines	$1.18	@	$1.23
Columbium-Tantalum, per lb., combined oxides 10 to 1 ratio	$1.05	@	$1.10
Tungsten Ore, per stu of WO_3:			
Foreign 60%, c.i.f. U. S. ports, duty extra	$12.00	@	$12.75
U. S. scheelite, f.o.b. mill	$20	@	(a)$22
Vanadium Ore, per lb. of contained V_2O_5 f.o.b. mines			31¢
Zinc Ore, Prime, 60% concentrate, Joplin, Mo., per ton.			$68

(a) Nominal. (e) Eff. 1958 shipping season.

METALLIC COMPOUNDS

Arsenous Oxide (arsenic trioxide) lb., in bbl. carload lots delivered			5½¢
Cobalt Oxide, 72½% to 73½%, per lb. eff. Dec. 1, '56	$1.52	@	$1.55
Copper Sulphate, 100 lb. eff. Oct. 24, '58			$11.65
Germanium Oxide, gram			27½¢
Molybdic trioxide, technical, per lb. of Mo	$1.46	@	$1.47
Imported, incl. 37¢ duty	$1.75	@	$2.05

ALLOYS

Ferrochrome 65 to 70%, per lb. of Cr. (4-9% C)			28¾¢
Ferromanganese, 74 to 76%, per lb., shipg. pt.			12¾¢
Ferromolybdenum, 58 to 64% Mo lb. of Mo contained	$1.68	@	$1.74
Ferrosilicon, 50% per lb. of Si f.o.b. shipping point (3-1957)			14.60¢
Ferrotungsten, 72 to 82%, lb. of W contained			$2.15
Ferrovanadium, per lb. of V delivered	$3.20	@	$3.40
Silicomanganese, max. 1½% carbon, lb. contracts			12.8¢
Spiegeleisen, per long ton, 10 @ 21% grade eff. Jan. 7			$102.50

NON-METALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (Canadian funds) ton:			
Crude No. 1	$1,470	@	$1,810
Crude No. 2	$788	@	$1,155
Spinning fibers	$353	@	$593
Shingle fibers	$190	@	$220
Paper stock	$120	@	$142
Waste	$82	@	$86
Shorts	$27	@	$75
Asbestos, f.o.b., Vancouver, B. C. (Canadian funds):			
Crude No. 1			$1,522
Spinning fibers	$494	@	$787
Shingle fibers	$142	@	$325
Asbestos, Vermont, f.o.b. Hyde Park:			
Spinning fibers	$353	@	$383
Shingle stock	$172	@	$190
Paper stock	$114	@	$145
Waste, stucco or plaster			$82
Refuse or Shorts	$39	@	$72
Barytes f.o.b. cars:			
Georgia, crude, per ton			$18
Missouri, 94% $BaSO_4$, per short ton	$16	@	$18
Crude oil well grade, min. 4.3% sp. gravity, st (a)			$18
Imported, c.i.f. Gulf Ports, st	$16	@	$18
Bauxite, long ton, f.o.b. point of shipment:			
Domestic, crude, 50 to 52% (not dried)	(c)$ 5.00	@	$5.50
Domestic, chemical, 55 to 58%	(c)$ 8.00	@	$8.50
Domestic, abrasive, 80 to 84 %	(c)$18.00	@	$18.50
Imported metallurgical, per lt, f.o.b. Br. Guiana, dep. on grade			$7.14
Feldspar, bulk ton:			
Potash or soda feldspar, 200 mesh, ceramic grade	$18.50	@	$22.50
Glass feldspar, white, 20 mesh	$10	@	$12.50
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37	@	$41
60% effective CaF_2	$33	@	$36.50
Acid 97% concentrate, bulk, ton (eff. 12-1-56)			$50.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00	@	$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington			$46
Mica—Domestic, f.o.b. mines. Punch 7¢ to 12¢ per lb. according to size and quality. Sheet clear 1½ x 2-inch, 70¢ to $1.10; 2 x 2-inch, $1.10 to $1.60; 2 x 3-inch, $1.60 @ $2.10; 3 x 3-inch, $1.80 @ $2.30; 3 x 4-inch, $2.00 @ $2.60; 3 x 5-inch, $2.60 @ $3.00; 4 x 6-inch, $2.75 @ $4.00; 6 x 8-inch, $4.00 @ $8.00. Wet ground, very fine, $140 @ $155 per ton. Bulk sales, dry ground; $30 @ $55 per ton. Scrap, $20 @ $30.			
Ocher, Georgia, ton in sacks	$26.50	@	$32.00
Pyrites, Spanish, per long ton unit of S. c.i.f. atlantic ports			Not quoted
Sulphur, per lt. f.o.b. U. S. mines: bright			$23.50
dark			$22.50
Mexican, for use in Mexico, per metric ton, f.o.b. mines, 280 to 395 pesos, depending on use	$22.40	@	$31.60
For export f.o.b. vessel, lt. dep. on grade	$22	@	$24
Talc, f.o.b. works, ton:			
New York, purified	$18.00	@	$20.00
Vermont, extra fine			$12.50
Tripoli, Missouri, ton:			
40-mesh, cream colored			$50.00

(a) Some restricted sales at $11.50. (b) Corrected. (c) Nominal.

IRON AND STEEL

Pig Iron, gross ton, basic, Valley Furnaces			$66.00
Steel, f.o.b. Pittsburgh, billets, net ton			$80.00
Structural shapes, Pa., Ala., etc. 100 lb.	$5.30	@	$5.50

27 TON pull test shows 4-way expansion of O-B Shell and Plug!

On the left, a plug from an O-B Bail-Type expansion unit. On the right, an identical plug after tensioning to 54,000 pounds — *6 times* the normal bolt load!

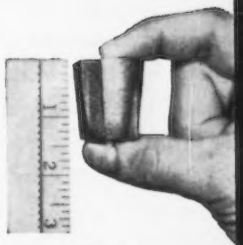
The test was made with a special bolt installed in a 1⅜ inch hole drilled in quartzite by an O-B customer operating a South African gold mine.

As shown in these unretouched pictures, the plug was compressed 22% and elongated over 30% by the tremendous pressures exerted against it. But, because those expansion pressures were distributed evenly four ways, reducing unit stresses to an absolute minimum, the O-B plug refused to break and release the bolt.

Four-way expansion is *another* reason why "they go up easy *and stay put!*"

OHIO BRASS COMPANY, MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd., Niagara Falls, Ont.

Ohio Brass



PLUG BEFORE TEST

PLUG AFTER TEST

O B
SHELLS AND PLUGS

4827-M

DOW | **NEW CHEMICALS** *play important mining role*

Recent economic shifts throw even more burden on mining processors. And more and more mining men are looking to chemicals to ease that burden. For several years modern mining chemicals from Dow have helped to improve ore processing and increase yield. How mining men use Dow chemicals and technical service to deflate operating costs and make recovery more efficient is highlighted below in condensed form for busy executive reading.

You may wish to check certain items in this advertisement and forward to those concerned in your company.

ROUTE TO:

_____

_____

_____

_____

MINING MEN MAKE SEPARAN FLOCCULANTS PAY OFF

Although it might be said that Separan NP10* was born with a mineral spoon in its mouth, it took a lot of cooperation on the part of mill operators to develop this new flocculating agent. In the past four years, Separan has gained widespread use in the industry. Prospects for the future include an entire family of Separan products for specialized recovery assignments.

*SEPARAN NP10 IS AN IMPROVED FORM OF SEPARAN 2610

In 1954, a new type of synthetic flocculant was christened Separan® in Dow laboratories and prepared for its debut to industry. Every characteristic of the new material pointed it toward a brilliant career in mining. Its settling rate with many different types of ore was unbelievably fast. Floc formations were almost ideal. Resultant filter cakes were thick and porous.

Will it work? The big question was, "Can Separan be made to function as well in the field as it does in laboratory tests?" The only way that question could be answered was by use under actual operating conditions in recovery equipment. Dow technical service men visited mills throughout the mining world.

At first, there were many problems to be solved. How much Separan was most efficient for a specific ore and a specific operation? What percentage solution should be used? How much time should elapse from one addition of Separan to the next? Where, when and how should Separan be introduced into the leached ore?

Pieces fit puzzle. The answers came slowly at first, but mining men were interested in the unique abilities of this new flocculant. Their diligent cooperation with Dow specialists soon paid off. In early 1955 the pieces of the puzzle began to fit together and Dow was able to intelligently advise other mill operators about the use of Separan.

Ore	Before Tons/ Day	After Tons/ Day	
Very slimy	50	400	at 1.0# Separan NP10/T
Blended	200	450	at 0.6# Separan NP10/T
Blended	250	500	at 0.5# Separan NP10/T
Good limestone	350	500	at 0.15# Separan NP10/T

Increased filtering rate resulting from use of Separan NP10.

Separan increases recovery capacity without adding equipment.

One of the most spectacular areas for Separan proved to be in the recovery of uranium. Today, this useful flocculant is in widespread use in the uranium mining industry. Dow technical servicemen (who average sixteen years of mining experience per man) are still working side by side with processors.

New family of flocculants. Meanwhile, in Dow laboratories, other specialists were developing Separan NP20, the newest addition to the Separan family of flocculants. Like Separan NP10, Separan NP20 is a new high-molecular weight polyacrylamid material. It has the highest flocculating activity of any commercially available flocculant. This is a part of a continuing Dow program to provide new and useful chemical "tools" for the entire mining industry.

DOWFROTH:
lively, long-lived frother

One of the best frothers yet devised for use in the flotation process is Dowfroth® 250. With as little as 25% of the quantity it takes with other frothers, it sustains a lively controllable frothing action. Dowfroth won't harm rubber parts in flotation machines and its froth can be readily laundered, pumped and thickened.

Easy to see why profit-minded mining management men are enthusiastic about Dowfroth. Says one, "A Dow field man urged us to try Dowfroth 250 for a particularly tough frothing problem. It did an excellent job and now we use it in all our flotation units."

★ ★ ★ ★

For information on any of the chemicals discussed in this advertisement write THE DOW CHEMICAL COMPANY, Chemicals Sales Department 930BD2, Midland, Michigan.

XANTHATES:
nine little Indian boys

Metallurgical engineers can choose from nine highly selective Xanthates.

Like the early American Indian, Dow Xanthates are so inconspicuous in their natural environment — in this case, flotation processing — that you have to look hard to find them. These nine highly selective collectors come in water-soluble pellet form, easy to handle and apply. No dust, no waste. They're essentially nonfrothing. This makes for better control all the way around. Even though you can't see them, a glance at the metallurgical results tells you Xanthates are there all right, silently, unobtrusively and efficiently doing their job.

Flotation Fundamentals is the name of a Dow handbook that's been on the mining "best seller" list for several years. Brand-new revised edition now available makes helpful reading for anyone concerned with mineral recovery. Contains hundreds of facts and figures, tables and metallurgical data.

DOW CHEMICALS BASIC TO THE MINING INDUSTRY

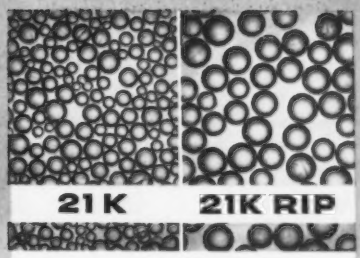
Flocculants • Ion Exchange Resins
Preservatives • Chelating Agents
Ammonia • Solvent Extractants • HCL
Frothers • Chlorine • Calcium Chloride
Alkalies • Flotation Agents

The Dow Chemical Company, Midland, Michigan

DOW

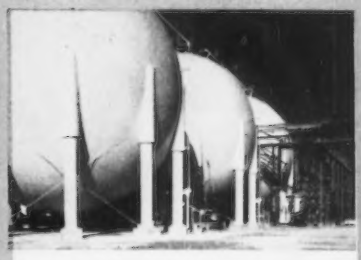
On the mining chemical NEWSFRONT

SOLVENT EXTRACTANTS. Dowsol* 12, brand-new organic phosphate extractant for solutions, pulps and slurries of uranium. A monododecylphosphoric acid (DDPA) as a 25-30% solution in kerosene . . . transfers metal values from solution to solvent. *TRADEMARK



ION EXCHANGE RESINS. Two new entries in the field, Dowex® 21K and Dowex 21K RIP, lend new effectiveness and economy to such tasks as removing and concentrating uranium from acid solution. Complete line of resins and expert technical service immediately available.

Z®-200. Something new in flotation reagents . . . a tailor-made unique, collecting agent for copper minerals and copper-activated zinc minerals where rejection of pyrite is of critical importance. Superior to any other collector in this application.



AMMONIA. New trend: Dow Ammonia used three new ways. Extracts nickel from low grade non-sulfide ores. Precipitates uranium from pregnant solution. Pressure leaches copper-nickel flotation concentrates to recover the two metals separately in powder form.

NEW DW20
Series G

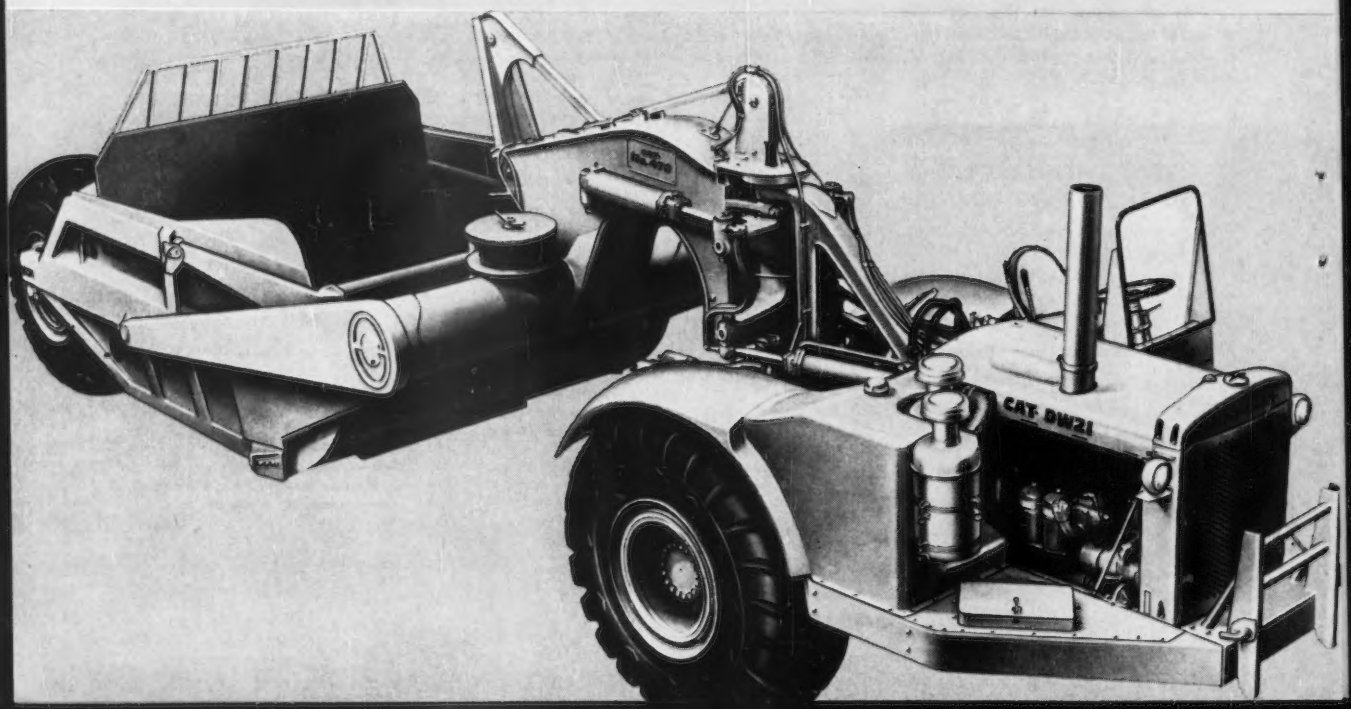
NEW No. 456
Series B

NEW HP —345 (maximum output)—increased 8%
NEW RIMPULL —39,565 lb. (maximum)—increased 12%
NEW SPEEDS —increased rimpull—provides up to 20% faster travel speeds under normal haul road conditions
NEW CAPACITY—19.5 cu. yd. (struck)—increased 8%
27 cu. yd. (heaped)—increased 8%

NEW DW21
Series G

NEW No. 470
Series B

NEW HP —345 (maximum output)—increased 8%
NEW RIMPULL —49,100 lb. (maximum)—increased 12%
NEW SPEEDS —increased rimpull—provides up to 20% faster travel speeds under normal haul road conditions
NEW CAPACITY—19.5 cu. yd. (struck)—increased 8%
27 cu. yd. (heaped)—increased 8%



CATERPILLAR'S PROJECT PAYDIRT

PROJECT PAYDIRT* *pays off for you*

NEW CAT DW20 and DW21 SERIES G TRACTORS NOW 345 HP

—plus new high-capacity LOWBOWL Scrapers for faster cycles and higher production!

For down-to-earth facts about these big new Caterpillar rigs, take a look at the box scores shown here. They summarize important increases in horsepower, rimpull, speeds, scraper ratings and tire capacities that pay off for you *on the job* with faster cycles, greater production and more profit!

Note that the increased HP of the DW20 and DW21 Series G, compared with the models they're replacing, gives 12% higher rimpull. This increased rimpull provides up to 20% faster travel speeds under similar haul road conditions. Equally important, this horsepower increase was achieved without any sacrifice whatsoever in the excellent torque characteristics inherent in the Cat Super-Turbo Engine. Torque rise of the engine in the Series G models is unequaled in the earthmoving industry.

In addition to the advantages featured in the box scores, the new Series G Tractors and their matching LOWBOWL Scrapers deliver the *proved* reliability of Caterpillar-built machines. To handle increased horsepower and increased capacity, both have been improved in design and structure. The tractors, for example, have stronger final drive gears and improved transmission shifter forks. The scrapers have stronger bowls, push frames, draft frames and aprons. All these and other improvements result in better service life, less maintenance and lower cost dirt.

Here are modern, heavy-duty wheel rigs geared to the needs of today's highly competitive market—rigs that meet your requirements for moving more dirt at lower cost than ever. Get the complete facts about them from your Caterpillar Dealer. Call him today and set a date for a demonstration!

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR

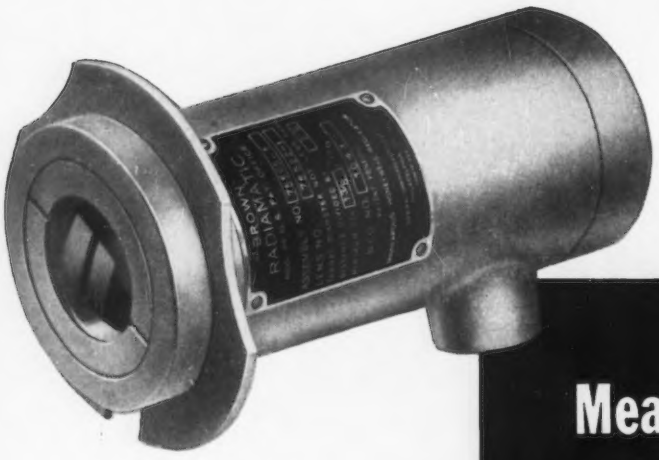
Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

BORN OF RESEARCH
PROVED IN THE FIELD

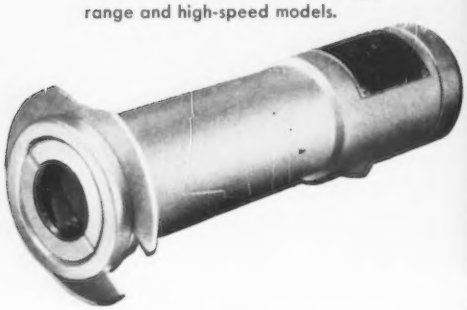
TIRES: 29.5-29 (28-ply rating) are now standard in place of the former 29.5-29 (22-ply rating)—a tire capacity increase of 16% to match the increased scraper capacity, heavier machine weight and higher speeds made possible by more HP. Note: On the DW20 Series G, the front tires remain the same—14.00-24 (16-ply rating).

CATERPILLAR'S PROJECT PAYDIRT

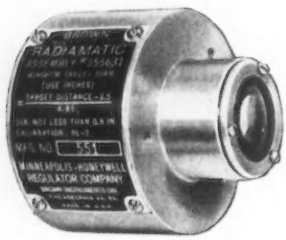
***PROJECT PAYDIRT:** Caterpillar's multi-million-dollar research and development program—to meet the challenge of the greatest construction era in history with the highest production earthmoving machines ever developed.



General Purpose *Radiamatic* Unit — for applications in the temperature range from 200 to 4000 F. Available in low, intermediate and high-range and high-speed models.



Small Target *Radiamatic* Unit — for temperature range from 1700 to 7000 F. Available in five models, depending on size of target and temperature requirements.



Miniature *Radiamatic* Unit — for range from 200 to 3200 F. For use where space is limited and small targets must be observed at short distances.

Measure "problem" temperatures with a *Radiamatic* temperature detector

USE *Radiamatic* detectors to measure the temperature of moving objects without physical contact . . . or for representative temperatures over large areas . . . or where abrasion, vibration, shock or corrosive atmospheres exist. *Radiamatic* temperature detectors are used extensively in pelletizing, in reduction and beneficiation of low grade ores—where thermocouples can't be used.

These detectors operate faster than thermocouples. You can easily interchange various types of *Radiamatic* units in your installation to meet changing requirements. They're reliable, maintenance-free production aids that give long service in any application. *Radiamatic* detectors have ambient temperature compensation to 350 F.

There's a complete line of *Radiamatic* accessories—sighting and target tubes, mounting frames, supports, air and water cooled fittings —where necessary—for varied installation needs. And there's a complete line of Honeywell indicators, recorders and controllers for use with these units.

Get complete details from your nearby Honeywell field engineer. He's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Aves., Phila. 44, Pa.

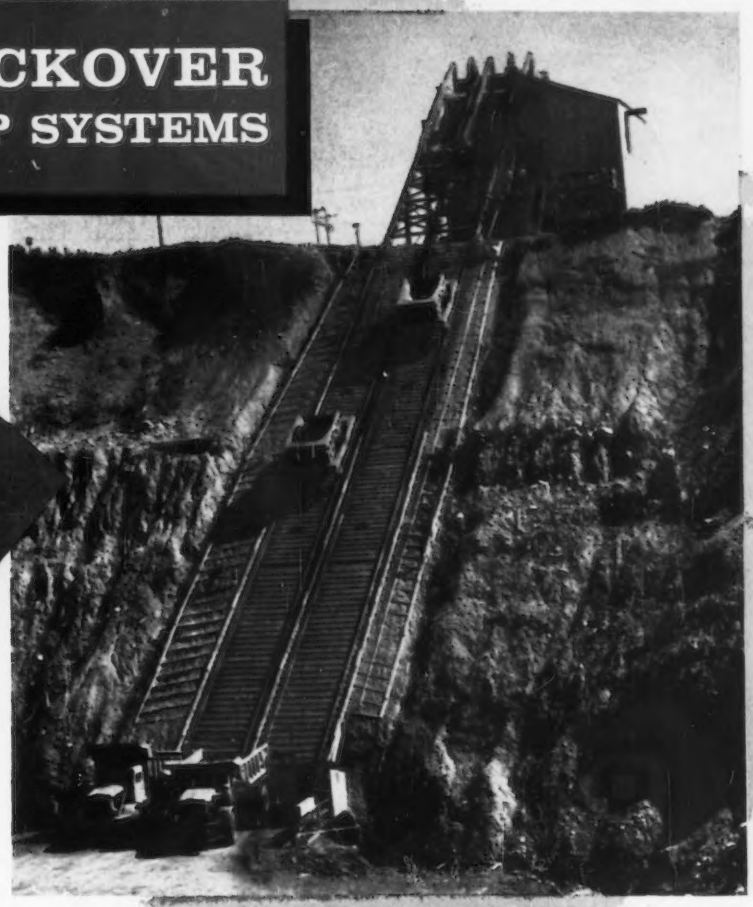
Honeywell

H HONEYWELL *First in Control*

Elevate materials at LOWEST COST PER TON

with ROCKOVER SKIP SYSTEMS

IN USE SINCE 1949



The ROCKOVER SKIP SYSTEM has proven to be the most economical method to elevate materials from open pits. It uses the shortest and fastest hauling route, has the lowest operating and maintenance costs and requires no large investment in parts and standby equipment.

Rockover Skip Systems require no expensive wide roads for pit access and require a minimum of personnel . . . are flexible to follow pit bottom as operations go deeper . . . haul either waste or ore at anytime . . . may be loaded at any desired bench and require no sizing equipment in the pit.

NICO SKIPS FROM 15 TO 50 TON CAPACITIES AVAILABLE

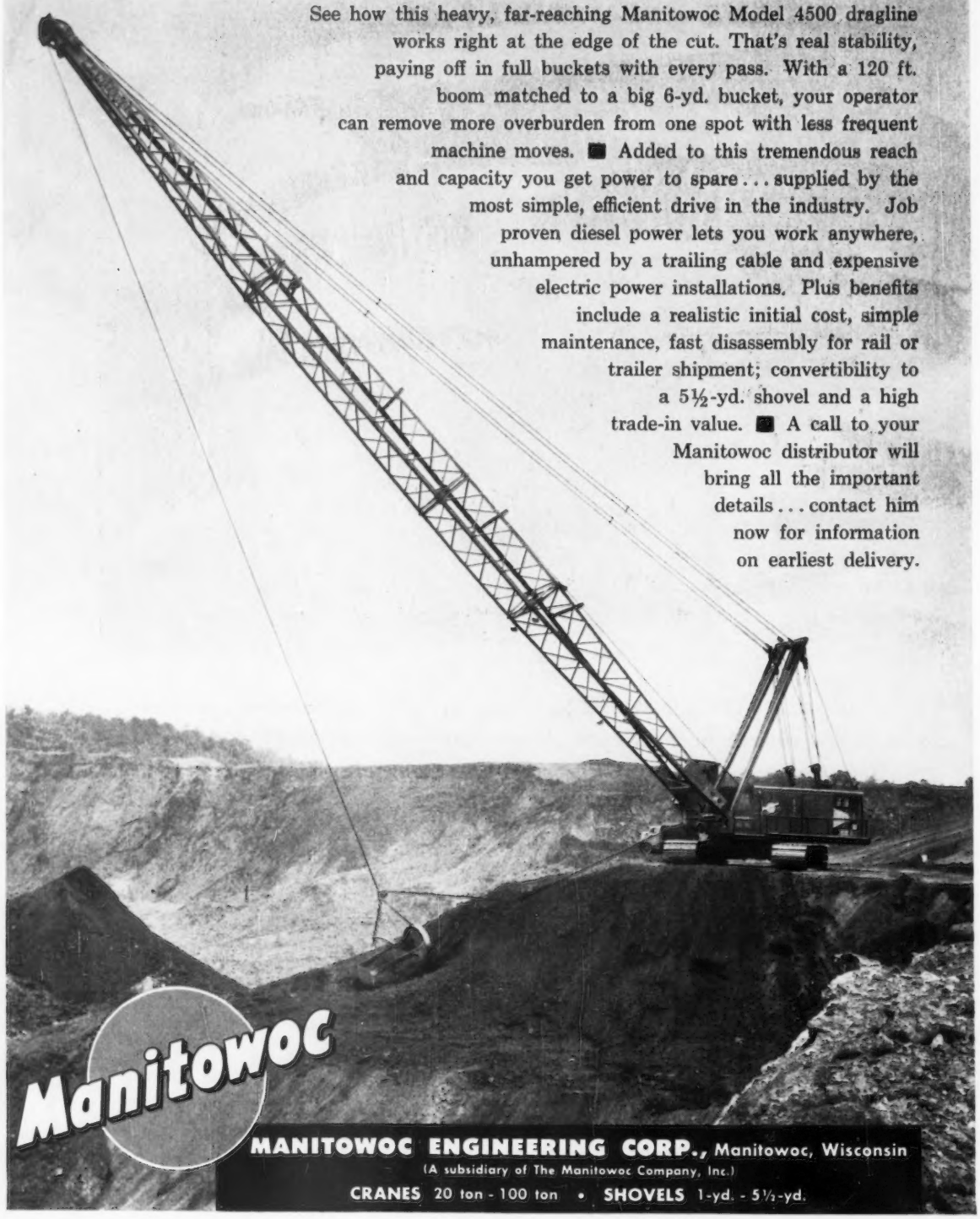
Write for illustrated brochure.

NATIONAL IRON COMPANY

50th Avenue West and Ramsey Street • Duluth 7, Minnesota

Subsidiary of Pettibone Mulliken Corp., Chicago 51, Illinois

Nothing fits **STRIP MINING**
like this fast, mobile 6-yd. *diesel-powered*
MANITOWOC!



See how this heavy, far-reaching Manitowoc Model 4500 dragline works right at the edge of the cut. That's real stability, paying off in full buckets with every pass. With a 120 ft. boom matched to a big 6-yd. bucket, your operator can remove more overburden from one spot with less frequent machine moves. ■ Added to this tremendous reach and capacity you get power to spare . . . supplied by the most simple, efficient drive in the industry. Job proven diesel power lets you work anywhere, unhampered by a trailing cable and expensive electric power installations. Plus benefits include a realistic initial cost, simple maintenance, fast disassembly for rail or trailer shipment; convertibility to a 5½-yd. shovel and a high trade-in value. ■ A call to your Manitowoc distributor will bring all the important details . . . contact him now for information on earliest delivery.

Manitowoc

MANITOWOC ENGINEERING CORP., Manitowoc, Wisconsin
(A subsidiary of The Manitowoc Company, Inc.)
CRANES 20 ton - 100 ton • **SHOVELS** 1-yd. - 5½-yd.

CYANAMID

REAGENT NEWS

"ore-dressing ideas you can use"

AEROFLOC® 550 Reagent now available in 20% solution form

Widely accepted as an effective, economical flocculating agent for finely-divided solid suspensions, AEROFLOC 550 Reagent in solution form is easier to use and often more economical than flake material due to lower handling and labor costs in the mill.

Stock solutions are quickly made up by pouring the 20% solution form of AEROFLOC 550 into a mixing tank and diluting to the desired 0.1% to 1.0% strength before feeding to the pulp or slurry to be treated.

AEROFLOC 550 Reagent solution is attractively priced. Ask our nearest office to send you a sample for test with complete instructions for use.

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High Explosives
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Blasting Agents
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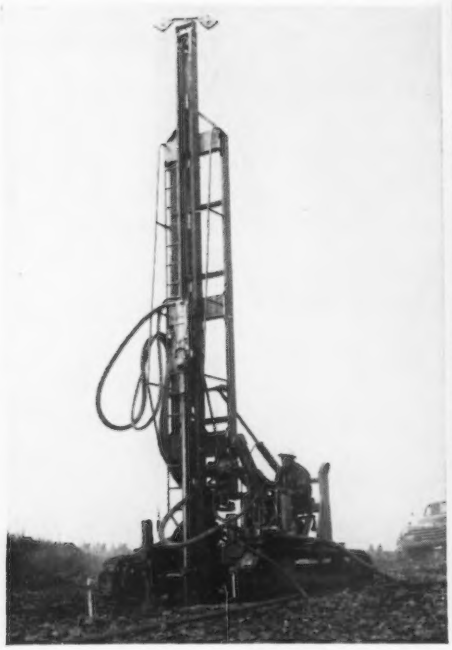

Gardner-Denver DH-143

Gardner-Denver Rotary 600

Pace Setters for Open Pit Production... Gardner-Denver Quality Drilling Equipment

For Blast Hole Drilling

SUPER 5½" DH143 CRAWLER DRILLS—self-propelled heavy-duty drill. Packs plenty of deep hole punch in all formations.

DELUXE "AIR TRAC"® CRAWLER DRILLS—all controls for drilling, drill positioning and crawler drive are centralized for ease of operation. Available with 4" or 4½" drills. Also "Air Trac" without remote controls.

NEW GARDNER-DENVER "MOLE-DRIL"*—for use with rotary rig. An in-the-hole drill in two models for drilling 4¾" and 6½" hole in hardest rock.

WAGON DRILLS—light- and heavy-duty for every need.

AUGER DRILLS—both wagon drills and "Air Tracs" can be equipped with rotary motor for auger drilling.

QUARRY DRILLING AND BROACHING DRILLS.

DEEP HOLE DRILLS, DRIFTERS AND SINKERS—a complete line.

AIR FEED LEG DRILLS—and air feed legs for sinker mounting.

DRILL FEEDS AND CONTROLS—to fit every drilling job.

For Quality Drill Steel . . .

SECTIONAL DRILL RODS—highest quality—shot-peened and carburized to stand down-the-hole gaff longer.

RING SEAL SHANKS—replaces old-type water swivel without adding additional length to drill.

COUPLINGS—extra long threads—made for longer drilling life.

For Air Power . . .

GARDNER-DENVER ROTARY PORTABLE COMPRESSORS—five models that offer water-oil cooling for all-weather operation, "THRIFTMETER"® fuel control, easy-to-get-at parts for speeding maintenance, clutch that eliminates cold-weather dry compressor starting. Sizes from 125 cfm. to 900 cfm.

STATIONARY AND SKID-MOUNTED COMPRESSORS—eight compact WB compressor packages that deliver continuous trouble-free performance. Water-cooled. Combination radiator-intercooler saves cooling water. Sizes from 1150 cfm. to 142 cfm.

For Building Your Own Jumbo . . .

JUMBO COMPONENTS—for tractor and truck mounting or building your own jumbo.

DRILL POSITIONERS—provide hydraulic swing and dump on end of booms for drill and feed positioning.

HYDRAULIC BOOMS—powered by creep-free hydraulic cylinders that operate at low pressures.

HYDRAULIC REMOTE CONTROLS—for remote-control operation of drills, feeds, drill positioners and booms from any centralized position.

Plus . . .

Bit Grinders • Centrifugal Pumps • Air Hoists • Drill Steel Shapers • Sump Pumps • Air Maintenance Tools Oil Forges • Air Line Oilers • Air Motors • Breakers Tampers

*Trade-Mark

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

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DISTRIBUTE and CONTROL FLOW of MATERIALS to

- SCREENS
- CRUSHERS
- MILLS
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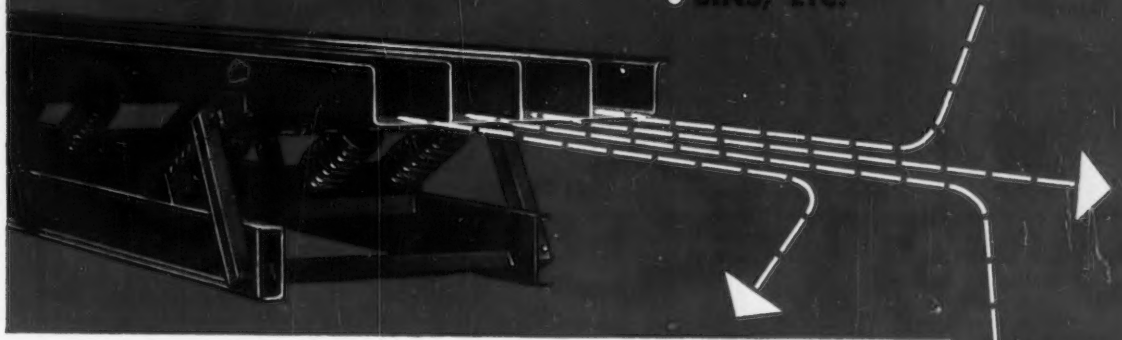

● **Low Headroom, Distant Delivery**—One Carrier Conveyor with a single drive and less than 30 inches of headroom distributes materials to a line of receiving equipment up to 500 feet long! Capacities up to 500 TPH.

● **Gentle Conveying**—Carrier's patented Natural-Frequency conveying motion (gentle "throws and catches") distributes even the most fragile products with no particle breakdown!

● **No Spillage or Contamination**—Smooth, one-piece troughs prevent spillage, hang-up, and contamination! Separate channels prevent intermixing. Dust covers and flexible connections can also provide completely dust-free, sanitary operation.

● **Increase Process Efficiency**—Vibration automatically levels materials in trough, resulting in even feeding across full width of screens, crushers, etc.

● **Dynamic Balancing**—Special design eliminates harmful vibrations — even in upper-floors of very light structures.

● **Low Maintenance**—Low input horsepower, few moving parts, and low drive stresses assure absolute minimum maintenance and downtime!

CARRIER
NATURAL-FREQUENCY CONVEYORS

Carrier Conveyor Corporation
211 North Jackson Street
Louisville 3, Kentucky

Please rush full information on Carrier Natural-Frequency Distribution Conveyors.

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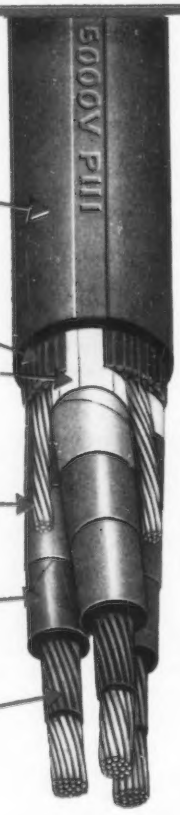
YOU CAN SEE WHAT MAKES ROEBLING MINE POWER FEEDER CABLE YOUR BEST BUY!



Tough, long-wear Roeprene® sheath wards off moisture, retards flame, resists oil, corrosion, abrasion. Meets flame-resistance requirements of Pennsylvania Dept. of Mines and carries symbol P-111.

All-rubber fillers for moisture resistance, splicing ease.

Tin-copper shield tape for added safety of operation.

Adequate ground wires, in contact with conductor shielding. Grounds equal more than 90% of circular mil area of single power conductor, for complete grounding and fault return.

Butyl insulation for heat-, moisture-, ozone-resistance. Rated at 90° C copper temperature through 5000 v; 85° C through 15000 v.

Semi-conducting tape around each conductor prevents excessive voltage stress and ionization between conductor and insulation.

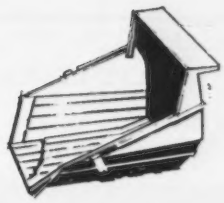
These are features that add up to longer, better, more economical service. Even at peak loading, rugged Roebling Mine Power Feeder Cable gives peak performance!

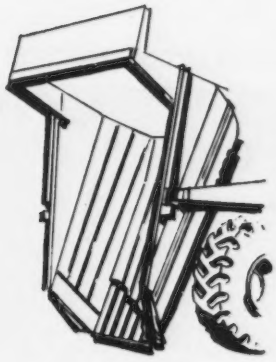
Pride of workmanship, special design features and finest raw materials make the difference. But don't take our word for it. See for yourself. Let us show you samples and give you recommendations and details as they apply to your application. Write to Electrical Wire Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

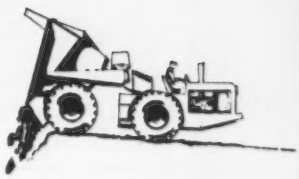
Haul problems?





Easier loading—Wide bowl offers large "target" for easy-loading without spillage. Open rear of body provides wide, low entry for dipper—an extra speed advantage for your shovel.

Resist body shocks, damage— Rear-Dump stands up under heaviest loading jolts. Bowl is all steel — no wood fillers. Floor is lined with heat-treated tool-steel strips, welded to solid billets laid over heavy steel plate. Sloping sides deflect load shock, quickly cushion small floor area with layer of material against rock-damage.

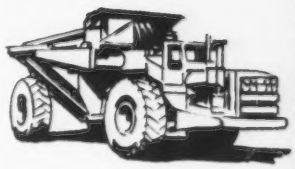


L-W Rear-Dump may be your answer!

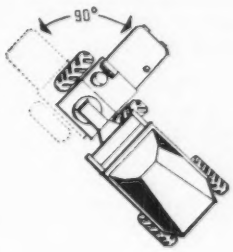
No two hauling jobs are exactly alike. Each has its own particular problems. There are long hauls and short . . . all types of earth-born materials. Some jobs have restricted loading and dumping areas. Others tough grades, rough temporary haul roads. And there are wide variations in maintenance and repair problems — depending on loads, abrasive material, shock, weather, and available facilities and servicemen. So finding the *right kind* of hauler to solve your present and future problems isn't easy. That's why we think you might like to check these "problem-solving" features found only on LeTourneau-Westinghouse Rear-Dumps. All these special advantages of this off-road hauler are available on all three sizes: 11, 22, 35 tons load capacity . . . 138, 210, 300 or 335 hp. And, to ensure steady earnings for you, other hauled units can be used behind same Tournapull® 2-wheel prime-mover. These include scrapers, bottom-dumps, flatbeds.

Quick, positive dumping— Flick of fingertip switch on control panel instantly activates point-of-action electric hoist-motor. Body raises quickly to desired angle. At full dump position, edge of bowl is low behind rear wheels . . . material cannot roll forward to lodge against wheels, nor pile under rear end. Streamlined body sheds stickiest material readily. Front-wheel drive keeps power and traction on solid footing—well ahead of rear wheels — when dumping over high banks.

Hauls anywhere— Machine's big, low-pressure tires—5 to 6′ tall, 1½ to 2′ wide — "float" machine over sand, mud, rocks, RR tracks, or other obstacles. Broad tire-lugs maintain traction in any type of material. Power-transfer differential puts up to 80% of power on drive wheel with firmest footing, when either powered wheel begins to spin. Electric pivot-turn, through geared kingpin, lets operator "walk" prime-mover out of soft spots. Dumping action can also be used to "hump" hauler off a soft bank.



Faster spotting—Positive, electric power steer, through geared kingpin . . . pivots prime-mover to right angle for short 90° turns. As a result, unit makes continuous U-turn in less space than Rear-Dump's own length. In dump position, it turns in only about ⅔ of over-all length! Result? You spot faster at the shovel . . . grizzly or hopper . . . and get away faster from congested pit or dump areas.



Simplified construction — Look underneath a Tournapull Rear-Dump . . . note that this machine needs no springs, no tie rods, no hose and pipe lines, no frame, no long drive-shaft that require maintenance and repair. In place of a foundation frame and body sub-frame, Tournapull prime-mover and trail-unit are hitched together by means of a high horizontal yoke. Yoke pivots horizontally on kingpin at front . . . then extends back along side of bowl, where it pivots vertically just above and ahead of rear wheels. This vertical and horizontal kingpin arrangement provides an easy oscillating action that eliminates most twisting, tilting strains . . . permits higher speeds on uneven ground.

R-1852-G-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

product:

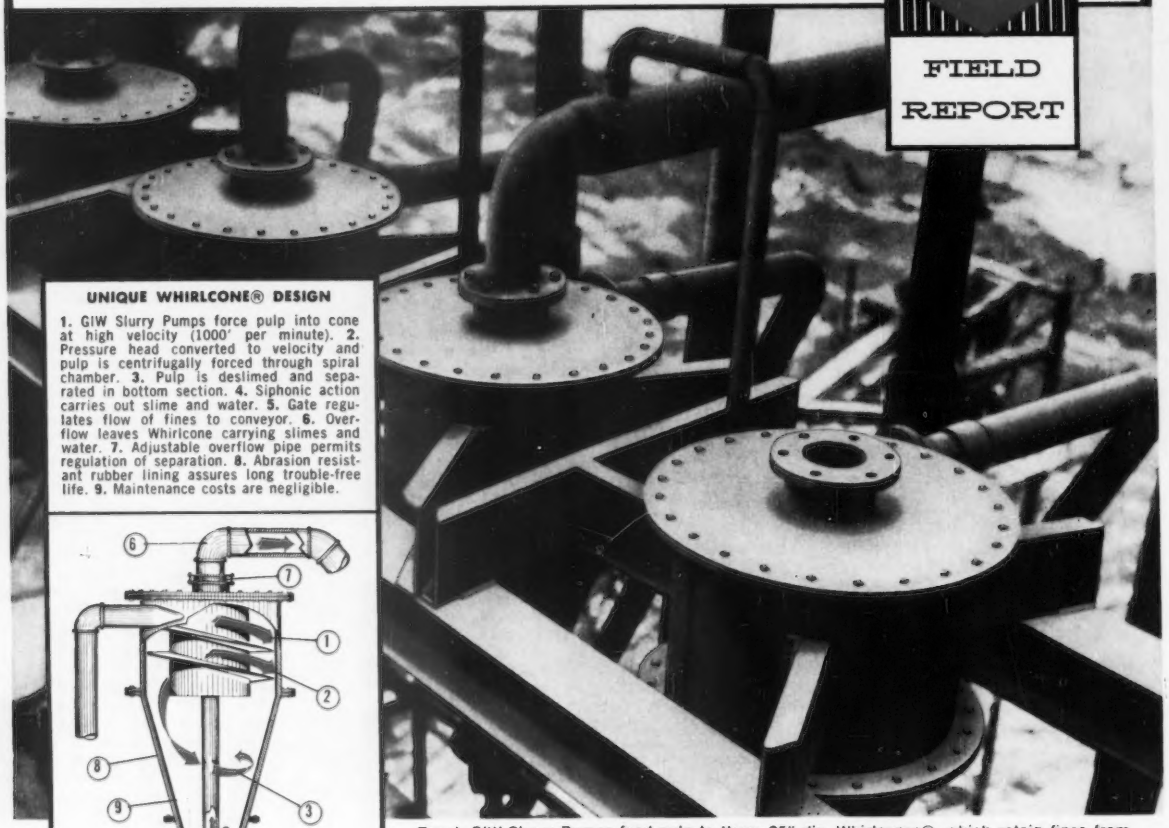
COTTRELL WHIRLCONE® SEPARATORS

customer:

BECKER COUNTY SAND & GRAVEL CO.

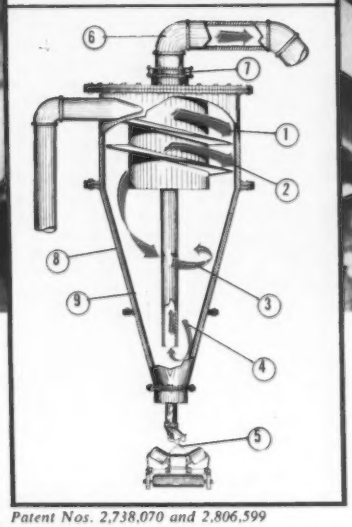
GIW

FIELD REPORT



UNIQUE WHIRLCONE® DESIGN

1. GIW Slurry Pumps force pulp into cone at high velocity (1000' per minute). **2.** Pressure head converted to velocity and pulp is centrifugally forced through spiral chamber. **3.** Pulp is deslimed and separated in bottom section. **4.** Siphonic action carries out slime and water. **5.** Gate regulates flow of fines to conveyor. **6.** Overflow leaves Whirlcone carrying slimes and water. **7.** Adjustable overflow pipe permits regulation of separation. **8.** Abrasion resistant rubber lining assures long trouble-free life. **9.** Maintenance costs are negligible.



Patent Nos. 2,738,070 and 2,806,599

Tough GIW Slurry Pumps feed pulp to these 25" dia. Whirlcones®, which retain fines from classifier overflow. Maximum recovery rate is 20 tons per hour per cyclone. The cones will handle material from −12 mesh to lightest slime.

Whirlcone® Separators solve difficult fine recovery problems.

The retention of fines in the −50 plus 200 mesh range posed a disturbing problem for the Becker County Sand & Gravel Co., of Cheraw, S.C., primarily because the large amount of water used in processing the sand and gravel washed out the desirable fines with the minus 200 slimes.

Fourteen 25" dia. Whirlcone® wet type cyclones installed parallel in four Becker plants solved this problem completely. Operating an average of 8 hours daily, they extract up to 100 tons of clean, fine sand per hour from wash water while the minus 200 mesh slime is discarded.

Recovered fines are used to bring sand up to specifications. Thousands of tons of valuable sand, formerly lost, soon paid for the low cost of the Whirlcones®.

GIW's highly efficient Whirlcones® are also being used in the mining fields to deslime, degrit, classify, concentrate, make dam and mine backfill and to dewater or thicken where the overflow can be returned to the process or it can be discarded.

They are available in diameters from 6" to 50". Capital cost including the pump is 20 to 50% of conventional classifiers.

If you are losing fines from material −12 mesh to lightest slimes, write today. Recommendations and literature will be forwarded promptly.

COTTRELL ENGINEERING
Division of
GEORGIA IRON WORKS CO.

GIW

Manufacturers of pumps, dredges, separators and accessories.

AUGUSTA • GEORGIA

Works for you...

...runs to its next job...

Let your neighbor share the cost of your new tractor

...and works for a neighbor

If the high-speed performance of a big, modern, rubber-tired tractor appeals to you — but your work-load doesn't seem heavy enough to justify the investment — here's a money-saving idea: *let your neighbors share your cost.* A modern tractor-on-rubber *works* so fast, *travels* so fast, that it can serve *several* users.

There are various ways to handle this "cost-sharing". Some owners rent their rubber-tired tractors to nearby pits and plants for a couple of hours a day, on a set schedule. Some furnish tractor-and-operator on a "call when needed" basis. Others include several stops on a daily cycle.

Must meet these requirements...

Whether or not the plan works depends on the speed and performance of your tractor. First, it must get *your* work done... quickly, economically. The tractor must be fast and mobile, so you can dispatch it to your "customers" easily. And, with this extra schedule of work, it must be able to "take it".

With these requirements in mind, consider how LeTourneau-Westinghouse Tournatractor® lends itself to this type of operation:

210 hp... excellent traction...

Tournatractor gets *any* work done in a hurry. With 210 hp, and excellent traction from 4 big, low-pressure tires, it matches or tops slow crawler-tractors in "push-power", in all but rarely-used speeds under 2 mph. Fast acceleration, big, sure-stop brakes, independent steering clutch speed up maneuverability. And its constant-mesh transmission gives you *instant*-shift, *non-stop* speed selection.

Versatile, too, Tournatractor can be equipped with dozer blade, Angle-dozer®, root rake, snow plow, side boom, tree stinger, push block, winch, railroad coupler. It will pull all standard drawbar tools. With a rear-mounted power-control-unit, it will operate cable-controlled scrapers, other cable-type attachments.

Drives to work anywhere

Tournatractor *runs* from job-to-job under its own power... doesn't need ramps, trailers, trucks. Its big tires roll over paved roads, open fields, rails, with equal ease. And its 17 mph speed lets you reach a pit 4 miles away in only 15 minutes!

Long hours, heavy work, never hurt rugged Tournatractor. Owners' cost records prove it to be remarkably economical to maintain. Its shock-absorbing tires, heavy steel framing, and load-smoothing torque converter keep this unit working productively day after day, month after month.

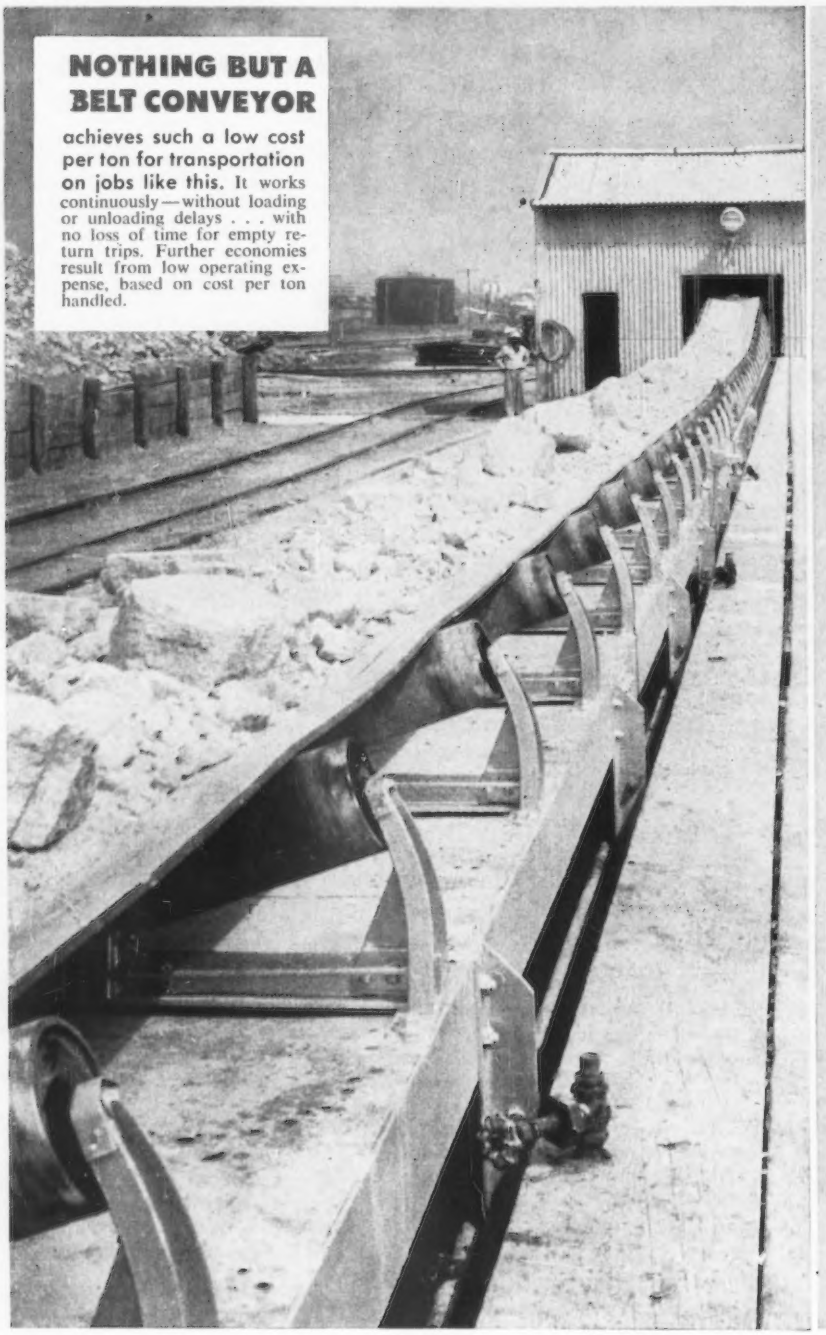
Talk over this double-duty profit possibility with your LeTourneau-Westinghouse Distributor. And ask for a demonstration of Tournatractor.

CT-1648-MQ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit



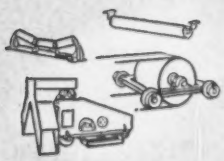
NOTHING BUT A BELT CONVEYOR

achieves such a low cost per ton for transportation on jobs like this. It works continuously—without loading or unloading delays . . . with no loss of time for empty return trips. Further economies result from low operating expense, based on cost per ton handled.

. . . AND NO ONE BUT LINK-BELT

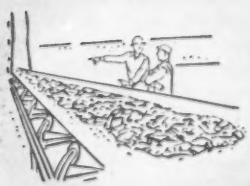
offers such complete service for engineering belt conveyors. Calling on unequalled depth of experience, Link-Belt can do a quick but thorough job of analyzing your requirements . . . back up recommendations with a complete line of equipment.

OVERALL ENGINEERING



COMPLETE EQUIPMENT

SKILLED ERECTION



ASSURED SATISFACTORY PERFORMANCE

No wasting of engineering manhours on details . . . no need to exchange drawings with scattered suppliers with Link-Belt handling your belt conveyor installation. You get all equipment from one source . . . the specialization that only industry's most comprehensive line of idlers—plus pulleys, drives, terminal machinery and auxiliary equipment—can offer. From design through erection, Link-Belt takes on total responsibility. Our nearest office has full information.

14.769

LINK-BELT

BELT CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World.

YOUR GRADER—

Chances are, you consider a grader a maintenance tool . . . a kind-of "necessary evil." But is it just that?

Think how a grader keeps haul roads in top-speed shape — thus increasing the number of round-trips your haulers can make daily. Or think of the extra working days you gain because ditches, cut by a grader, let water run off faster.

Objective . . . increased production

The net result of most grader work in mines, quarries, and pits, is higher output . . . increased production. In a sense, the extra tonnage you get — due solely to work of your graders — is really *their* production. It's output you wouldn't get without graders . . . couldn't get without added expense.

So! While your grader may be a "maintenance" tool in function, it is actually a "production" tool in results. That's why you will want to select your graders carefully, on the basis of work-output. You'll want machines that can handle *all* your blade-work *fast* . . . that can help you get the "last ounce" of tonnage with your production equipment.

L-W "660" does more work, faster

You'll find that a big L-W Adams† 660 grader can cut deeper, push more dirt, move it faster than other graders of similar size, price, and power. "660" gives you greater work-output than others — mainly because of its wide selection of power-speed combinations, which let you do more of your work at full engine-power. The L-W grader also provides extra, faster forward and reverse speeds to save you time on traveling, maneuvering, and backing-up for the next cut.

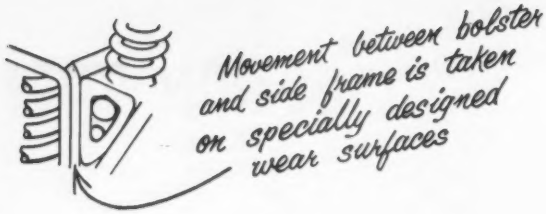
This profit-boosting grader is offered in 2 power options: Standard "660" with 160-hp diesel and constant-mesh transmission, or POWER-*Flow*® 660 with 190-hp engine and torque converter. Five other L-W Adams model graders — 60 to 135 hp — also available.

Call or write for complete information about features that make LeTourneau-Westinghouse machines the most profitable graders you can own.

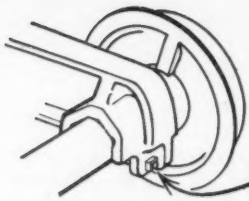
†Trademark G-1884-MQ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

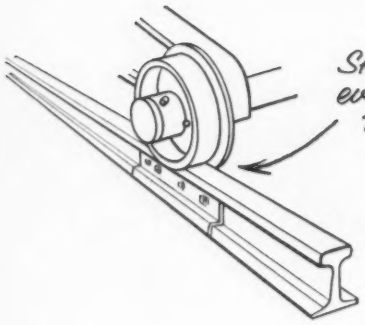
A Subsidiary of Westinghouse Air Brake Company



Movement between bolster and side frame is taken on specially designed wear surfaces

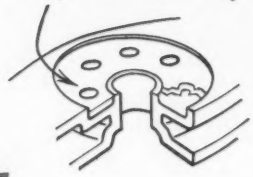


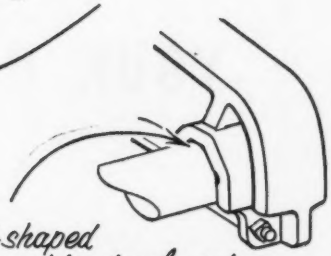
Quick wheel change



Smoother ride even on rough tracks

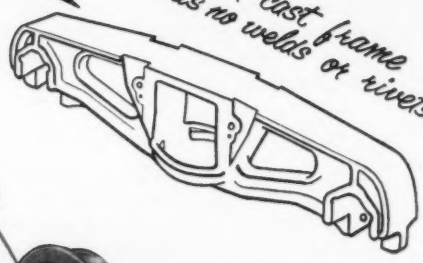
Large center bearing for longer life



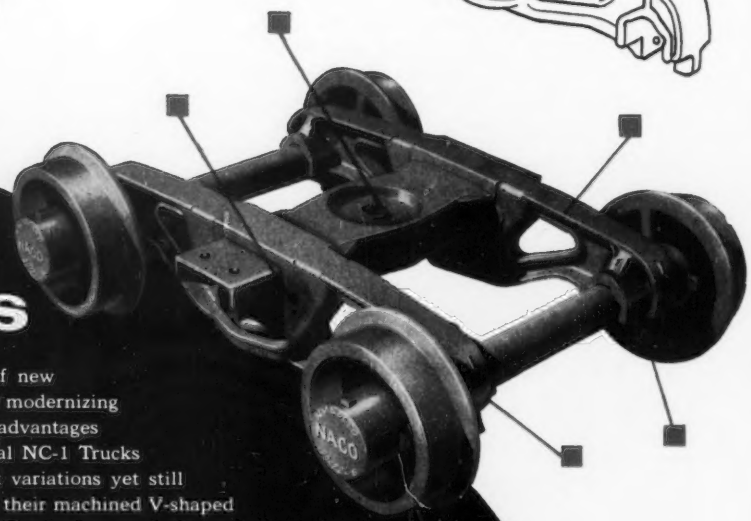


V-shaped machined axle grips for controlled flexibility and truck alignment

Integral cast frame has no welds or rivets



Check these "plus" features OF NATIONAL NC-1 TRUCKS



If you're considering the purchase of new 8-wheel mine cars . . . or if you're thinking of modernizing older cars—*now* is the time to check the advantages of National NC-1 Trucks. National NC-1 Trucks have controlled flexibility for track variations yet still maintain truck alignment through their machined V-shaped axle grips. In addition, NC-1 Trucks have a built-in shock absorbing mechanism.

You get more out of your mine car investment per workshift . . . per day . . . per year. And at the same time you minimize spillage . . . get greater protection for your equipment, track and structures . . . slash maintenance to a new low.

Yes, *now* is the time to check National NC-1 Trucks—they make sense for 8-wheel mine cars . . . *make dollars for operators*, too.

- WILLISON AUTOMATIC COUPLERS
- RUBBER CUSHIONED UNITS
- NC-1 CAR TRUCKS • NACO STEEL WHEELS
- NACO STEEL LINKS & SWIVEL HITCHINGS

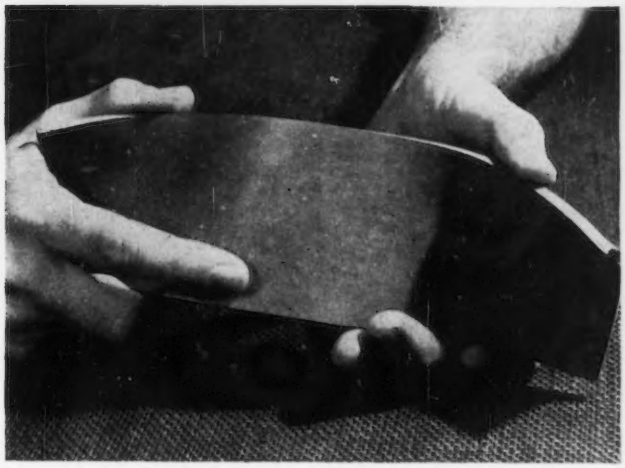
AA-8077

NATIONAL MALLEABLE and STEEL CASTINGS COMPANY

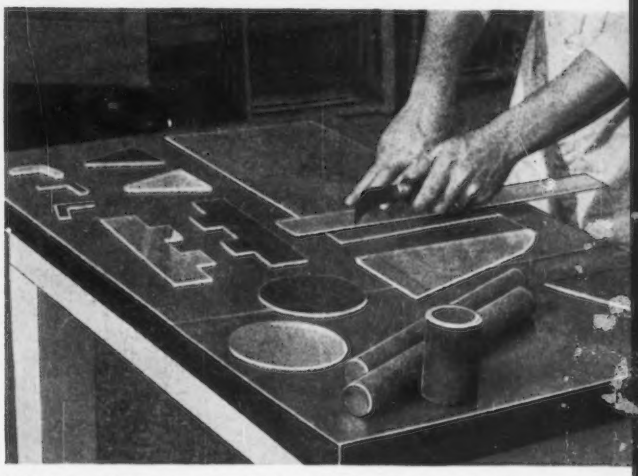
Established 1868 — *Cleveland 6, Ohio*

E&MJ NEW PRODUCTS DIGEST

In this issue—how sheet explosive hardens manganese steel, more on the McNutt spiral, round-the-corner scraping, a rotary screw compressor, plus 60 other new products and literature notices.



POWERFUL high explosive in flexible sheet form can be used for many purposes besides work hardening manganese steel.



SHEET explosive is essentially PETN and is available in 10x20-in. sheets with powder loadings to suit the purpose.

Explosive Hardened Manganese Steel—A New Kind of Austenitic Steel (1)

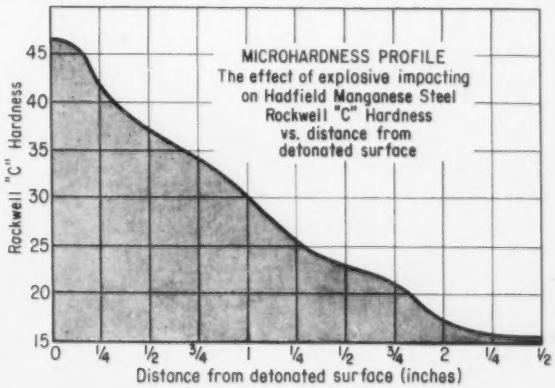
NORMAL AUSTENITIC manganese steel (containing 12% or more manganese) can be cold work hardened better, faster and in more intricate forms with the use of the proper explosives than it can with conventional shot peening, hammering, or pressing techniques. Cost-wise, the process may not cut production costs, but it will give the user a new kind of work hardened austenitic manganese steel—one that has been hardened to a depth of 1 in. to as much as 2 in. compared to the 1/20 in. obtained by shot peening.

The process was invented and patented by Norman A. MacLeod of Altadena, Calif. in 1955. Du Pont developed the special sheet explosive EL-506A found to be required for successful impact hardening, and purchased the patent after two years of research and development work. The first field tests of the process were done at Easton, Pa. during the summer of 1957 with the cooperation of the Taylor-Wharton Co., producers of manganese steel who are now equipped and are using the process commercially.

Ordinary manganese steel castings have a tensile strength of 135,000 psi, a yield strength of 52,000 psi, and an elongation factor of 55% in a 2 in. specimen. The normal hardness of the piece after casting and heat treatment, which make it austenitic and tough, is 180 to 220 Brinell. The material can be work hardened to as high as 500 Brinell where it is thought that the tensile strength is doubled and the yield strength increased fourfold.

Explosive work hardening has given results in the range of 500 BHN; but usually hardnesses of 350 to 400 are found more practical. The tensile and yield strengths are, of course, then less than the maximum but greatly increased over the normal austenitic material. Several different explosive treatments can be used depending on the end use of the castings, and both the explosive loadings and number of times the pieces are impacted have been found to affect both the surface hardness and the depth of the hardened zone.

Regular austenitic manganese steel has been used successfully for more than 60 years and has established an enviable record of dependability, toughness, and resistance to certain types of abrasion where high impact loads are involved. It has been found the ideal material for crusher plates, mantles, concaves, shovel buckets, dipper teeth, crawler pads, railroad crossings, frogs, switch points, and a large variety of other pieces where toughness is required and emergency fracture failure cannot be tolerated. In fact, it is called the "toughest



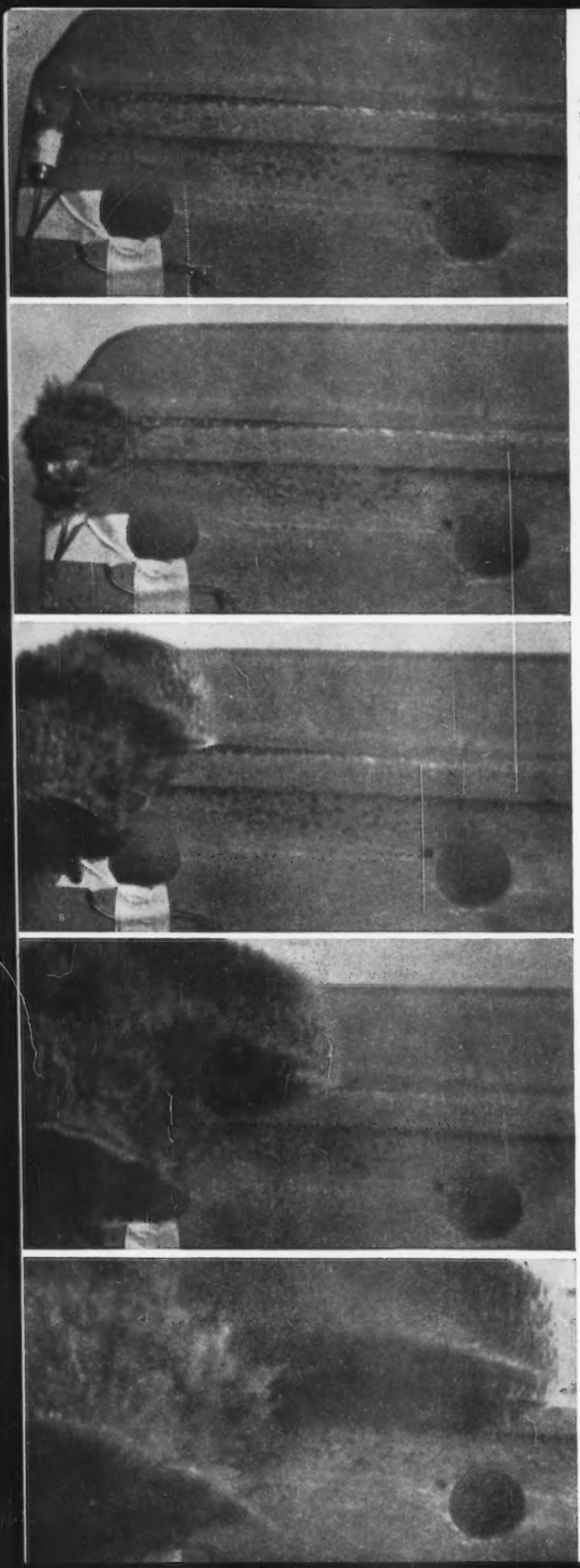
METHOD is versatile. Depth and degree of hardness, and area hardened can be varied. Thin strips can cut steel.

steel known" by the American Manganese Steel Div. American Brake Shoe Co., largest manufacturers of this special steel.

The great advantage of explosive hardening is that the process is used to increase the strength, stability, and wear resistance of a tried and proven steel, and can be used on a number of shapes and sizes that cannot now be economically work hardened mechanically. The deep hardening effect means less peening and metal flow under hard use.

Taylor-Wharton is successfully using the explosive hardening process both under water in a specially constructed pond at their Easton, Pa. plant, and in the open in a specially equipped abandoned quarry near their High Bridge, N.J. foundry. According to the MacLeod patent, shooting underwater is an advantage, but du Pont believes this is not necessary except in congested areas where noise may be objectionable. In some instances the process can be used in the field, at a mine, mill, or quarry providing the operation is handled properly. In other instances the pieces will have to be prehardened and finished at the foundry.

Du Pont built a pilot plant for hardening customers' test pieces at their Potomac River explosive plant at Falling Waters, W. Va. and have hardened castings for foundries and



◄**TIME SEQUENCE** shows an explosion in action. Interval between first and second frames is 0.0000039 sec; between second and third 0.0000104 sec; third and fourth, 0.0000169.

equipment manufacturers, as well as mining and mineral processing companies. Du Pont and Taylor-Wharton are equipped to harden castings for various people and are willing to quote prices for this service on specific jobs. Taylor-Wharton are already doing this work for their track work and commercial casting customers.

Du Pont may eventually do commercial treating at plants of their own but, at the present time, intend to offer the method to the 30 odd manganese steel foundries around the U.S., and to mining and mineral processing firms. For details and help in field testing the process at your foundry, shop, or operation, write direct to C. M. Pomeroy, technical representative, explosives department, E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Dela.

Flexible sheet explosive used for the du Pont metal hardening process looks and feels like a piece of vinyl floor tile. It is designated as EL-506A, and has been classified by the Bureau of Explosives as a Class A, Type 3, high explosive under paragraph 73.53(c) of the I.C.C. Regulations. The actual explosive is the well known PETN, widely used in Primacord, bound together with a flexible rubber-like material.

In heat stability tests the explosive was exposed to 250 deg F heat for 24 hours and did not decompose. Other samples heated during classification tests were subsequently detonated at its normal velocity of 6500 to 7000 meters per sec. When samples of the explosive were placed in a wood fire, they burned with no more intensity than the wood itself and did not detonate.

With regard to shock sensitivity, an 18-lb steel ball was dropped from a height of 10 in. onto a 2-in. sq section of EL-506A placed on a ½-in. thick steel plate without detonation occurring. When 30-caliber bullets were fired from a distance of 15 yd into the sheet explosive placed on cardboard, wood, or steel plate, no detonations occurred. When bullets were fired into five layers of sheet explosive attached to a solidly backed steel plate, two detonations and five failures resulted from seven tests.

Flexible sheet explosive is available from du Pont in various thicknesses. These thicknesses are determined by the weight of explosive in grams per square inch of material and range from one gram per square inch to eight grams per square inch. Although du Pont have not established the upper limit, it is quite easy to combine layers of thinner sheets to obtain thickness and loads greater than 8 grams per square inch. The most readily available type at this time, and the one which has been widely used for metal hardening, is the 4 gram per square inch material.

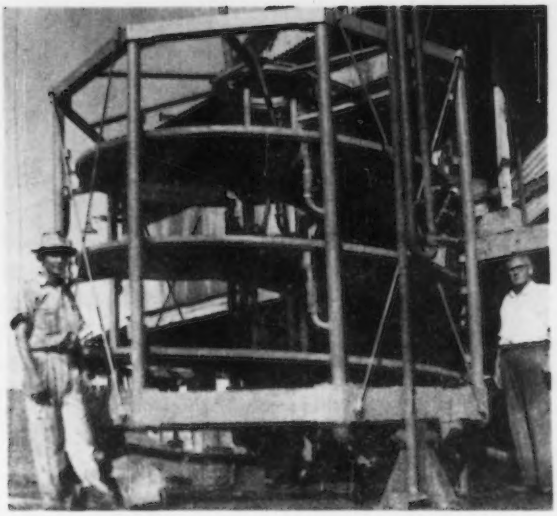
The current price is $5/lb in 50-lb lots or greater, and $6/lb in quantities of less than 50 lb with a minimum order of 10 lb. Prices are f.o.b. Falling Waters, W. Va.

Prices are based on relatively small development quantities of sheet explosive produced for experimental purposes. Selling prices on production quantities of the material will be furnished on request. Sheet explosive is supplied in 50-lb cases in sheet size 10 x 20 in. which has been found to be a convenient size to handle and use.

Powerful high explosive in flexible sheet form can be used for many applications in addition to hardening manganese steel. Narrow strips can be glued to steel sheet or plate and relatively clean cuts made when the explosive is detonated. The explosive is not affected by water, so underwater cutting of wood or steel is possible. Many other applications can undoubtedly be found where a fast powerful concentrated force is needed for either constructive or destructive purposes.

Du Pont recommend that, even though EL-506A sheet explosive is more insensitive than many commercial explosives, it can be shipped, stored, handled, and used with all the common sense practices and restrictions in effect for the commercial types. For example, when sheet explosive is used for any purpose, including hardening metal castings, people in the vicinity of the blast should take adequate cover and be well protected both from concussion and possible flying debris.

◄**EXPLOSION** in full bloom—0.0000299 sec from first squirt.



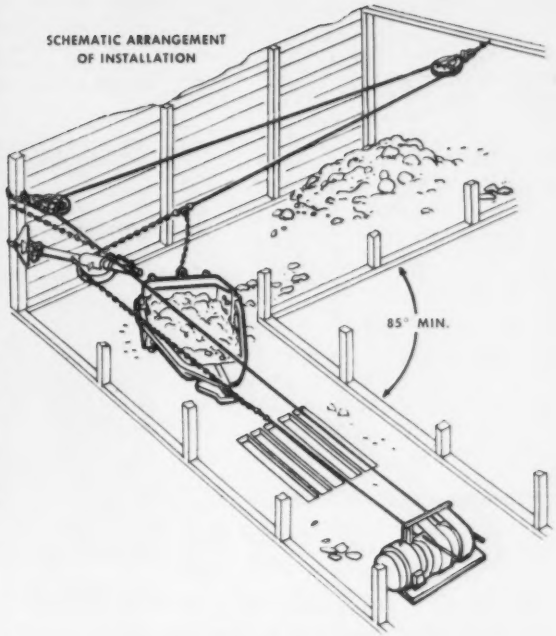
More on the McNutt Spiral Concentrator (4)

In August New Products Digest, we discussed briefly the McNutt spiral concentrator. Here are further details as given to us by Mrs. Russell M. McNutt, currently in the U.S. from South Africa. At one operation, a spiral is used to treat tailings from a large chrome washer—result: over 1,000 tons of high-grade chrome concentrate is recovered each month. McNutt spiral employs specific gravity, centrifugal force and vibratory and oscillatory energy to concentrate. At one installation, the total installation cost was recovered within 17 days of operation.

On feed sized 0 to ⅜ in., with one operator for several machines, one McNutt spiral operates under these feed rates in tons per hour—chrome (7 to 9.5); ilmenite (12 to 14); tin bearing ores (10 to 12); tungsten (8 to 11); bauxite (11 to 14); lead (10 to 12); gold (10 to 14); and pyrite (7 to 10). Power requirement is 4 hp.

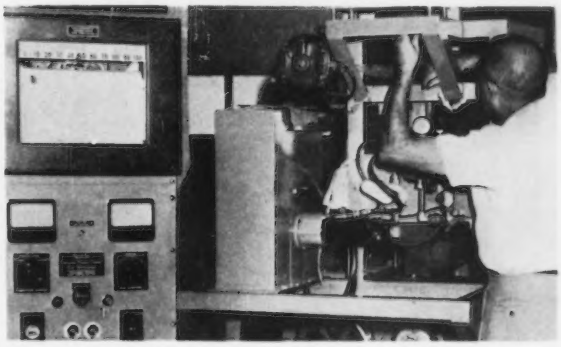
Rotary Screw Compresses Air Efficiently (5)

Two years of field tests are behind Atlas Copco's latest in air compressors. Two-stage, positive-displacement compressors develop four compression cycles per revolution and operate at speeds of 3,600 rpm. Three sizes are now available in the U.S.—6,700, 10,000 and 19,250 cfm. Two rotaries were installed at Kiruna Iron Ore Mines, Lapland, and operated a combined total of 8,900 hours on full load at delivery pressures of between 105 and 115 psi. Advantages—oil-free air, low maintenance (only bearings and timing gear are subject to wear), motor efficiency is high and synchronous motors can be used, cooling water consumption is low, and the machine has compact design.



Round-the-Corner Block for Slusher Scraper (6)

Hundreds of Alloy Steel & Metals Co. Pacific Round-the-Corner sheave blocks are already in service, according to the company. It is not necessary that the slusher operator keep tension at all times on the in-haul and back-haul cables; nor is it necessary that the operator have considerable experience. Customers report day-in-day-out performance without missing a pass of the scraper around the corner. R-T-C's can be used in these mining operations—square set, sub-level development, driving "T's" for the coyote holes, and room-and-pillar. Users report as much as 50% reduction in slushing costs. Special brackets and swivels have been developed.

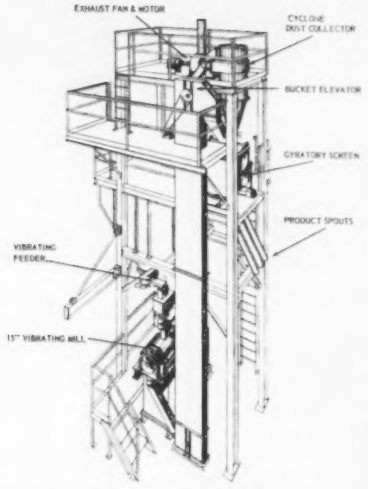


Cominco to Use X Rays in Flotation Plant (7)

Developed as a continuous process control unit, the Norelco X-ray spectrograph shown above is being shipped to Cominco by Philips Electronics, Inc. Machine will monitor flotation tailings for zinc. A gauze-covered vacuum drum will pick up material continuously from the tailings line. Pulp will be scraped from the drum, passed through a mixer, then extruded into a ribbon ½-in. thick and 2-in. wide. As the ribbon passes under the X-ray beam, a pen record on a strip chart indicates zinc content of the tailings 60 seconds ago.

At the engineering and mining experiment station, Rapid City, S. D., Norelco X-ray diffraction and spectrographic instruments are used to assay ore deposits and prospecting samples for gold, uranium, beryl, columbite-tantalite, spodumene, amblygonite, mica and feldspar, and others.

For more information, mark reader reply card and mail to E&MJ.



Vibratory Ball Mill (23)

A pre-engineered dry grinding plant is now available from Allis-Chalmers Mfg. Co. consisting of a 15-in. vibratory ball mill, screens, feeders and cyclone dust collectors as illustrated in the drawings. Plant capacity is up to one ton per hour. Field-tested vibratory ball mill has proven capacity of up to 40 times as much as conventional mills of equal grinding volume. Unit takes up only 127 sq ft of floor space, and can readily be installed in an existing building. The list of chemicals, minerals and ores ground successfully in the mill is too long to attempt here. Check for more details.

Ultraviolet Detector Spots Smoke, Fire or Vapor (24)

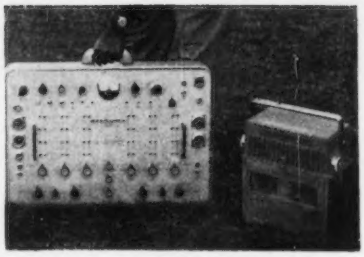
Where there's smoke, fire or vapor, this device will detect it and set off appropriate alarms, according to Minneapolis-Honeywell. M-H is working with a major coal mining equipment manufacturer on the application of the tube to coal mining. Dr. Finn J. Larsen, research director says that "the unique capabilities of the new tube will permit development of new and better fire and explosion warning systems . . ." Detector is not influenced by ultraviolet rays given off by artificial lights, and can detect any one or all three of the conditions. Mathias J. Grundter is demonstrating the device with match, pipe and beaker of combustible vapors.

Geodimeter Surveying (25)

According to Berg, Hedstrom & Co., Inc., the Model 14 Geodimeter is accurate in the 50-ft to 3-mile range or greater, depending on visibility. Average error is less than 0.04 ft, plus or minus 5 millionths of the distance. Personnel can be trained to use the instrument in less than three days. Instrument is suitable for photogrammetry and traversing on short lines, in the field, pit or underground. Model 14 employs a modulated light-beam that is reflected by pre-established and unmanned reflectors. The narrow reflected light beam enters a phototube multiplier which converts the light to electrical energy. Readings are then obtained by nulling a meter.

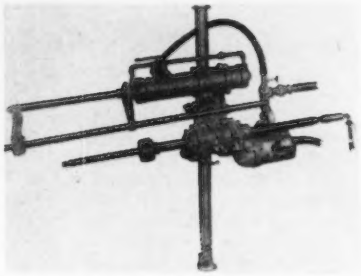
Gravity Meter (27)

New TI-Worden Master gravity meter recently announced by Texas Instruments Inc. has even superior accuracy to the previous models, due to a low power temperature stabilizer attached to the instrument. Weight is 7½ and 10½ lb, depending on class and model.



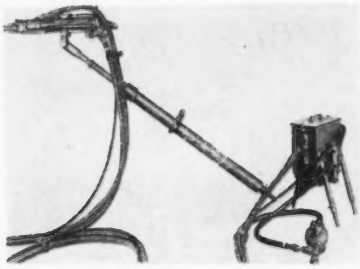
Portable Seismic Amplifier (26)

An all-transistorized, regulated power supply and aircraft-type 12-volt battery are contained in the case of Texas Instruments Inc.'s Explorer, Model 8000 seismograph (24 channels). Package weighs only 57 lb. Explorer can be used with any seismic camera or magnetic recorder.



Diamond Drill (28)

Chicago Pneumatic Tool Co. is introducing a new, powerful diamond drill, the CP-65, for blast hole, coring or grout hole work. Picture above shows drill swung down and rod puller in action. High torque rotary motor packs 50% more power than previous models for drilling to 600 ft (EX or EW fittings) with ordinary mine compressed air. Motor is reversible. Drill weighs 200 lb. Rod puller is furnished extra and is strongly recommended for pulling more than 100 ft.



Dustless Jackleg Drill (31)

New dry, dustless jackleg drill eliminates the need for water in drilling and provides a continuous ore sample, according to Le Roi Div., Westinghouse Air Brake Co. Bureau of Mines approval has been given to Model LLV drill and LX-1 tank. Drill is used with Le Roi AL90 and 92B airlegs using 1-in. hex. 4¼-in. steel. Drill operates at 80 psi air on 105 cfm. Hose connections are ¾ in.

For Your Files

This selected manufacturers' literature is free unless otherwise specified. If item is for sale, send request and money direct to manufacturer.

Exploration and Mining

DOPPLER NAVIGATION for exploration over undifferentiated terrain can guide the plane, needs no ground stations or transmitters, works whether or not maps or aerial photos are available, cuts data processing time and reduces exploration cost according to literature from Aero Service Corp. **(60)**

HOW PHOTO contour maps aid the engineer is the title of a paper available from Aero Service Corp. **(61)**

GEOPHYSICAL prospecting services and instruments available from AB Elektrisk Malmletning are discussed in a 15-page leaflet. **(62)**

TRUCK-MOUNTED CRANE—The Thew-Lorain 8-ton 107—converts to shovel, dragline, clamshell and backhoe, according to literature from Thew Shovel Co. 11pp. **(63)**

CUT CYCLE TIME with International Payscraper earthmovers is the title of a bulletin (CR07330H 5-14) from International Construction Equipment, International Harvester. Bowlscrapers have either 20 or 14 cubic yd heaped capacity. 13pp. **(64)**

WHEELED BACKHOE loader designed by J. I. Case Co. is featured in an eight-page bulletin (CUS-110) on the Case utility Model 310b (42hp). **(65)**

BREAKING the barriers to profit, a booklet from Caterpillar Tractor Co., contains on-the-job photos of Caterpillar-built equipment at work, plus case histories. 8pp. **(66)**

CATERPILLAR PRODUCTS—a 24-page catalog from Caterpillar Tractor Co.—features the entire company line of engines and earthmovers. **(67)**

ROTARY COMPRESSOR, the world's largest portable, according to Le Roi Div., Westinghouse Air Brake Co., is described on a 2-page data sheet (P-114). Le Roi 1200RD2 is a 1200 cfm machine. **(68)**

ROTARY COMPRESSOR with two-stage compression and 365 cfm design is illustrated in Worthington Corp.'s two-page data sheet on the portable Blue Brute Model 365. **(69)**

ROTARY COMPRESSOR 365RD2, a portable 365 cfm design is illustrated in 4-page bulletin (P-121B) from Le Roi Div., Westinghouse Air Brake Co. **(70)**

STATIONARY COMPRESSORS—the Atlas Copco AR Series—that can deliver from 330 to 3,220 cfm at 100 psi, depending on size, are illustrated by Atlas Copco. **(71)**

FLUID DRIVE EQUIPMENT from Oilgear Co. is illustrated in a 12-page bulletin (10051-G). **(72)**

SPEED REDUCERS from Allis-Chalmers Mfg. Co. in the Shaftex line with output speeds of 40 to 400 rpm in horsepower range of ½ to 40, are detailed in a 4-page bulletin (20 B 9053). **(73)**

AIR MOTOR bulletin (5072A) prepared by Ingersoll-Rand Co. features over 100 sizes, shapes and designs in power range from 0.3 to 24hp with running speeds from 50 to 2580 rpm. 16pp. **(74)**

SILICONE insulated cable for high temperature application as high as 392 deg F is being introduced in Simplex Wire & Cable Co.'s latest catalog-bulletin. **(75)**

C-L-X SHEATHED CABLE catalog has been published by Simplex Wire & Cable Co. Contains engineering data, tests results, applications and sizes available. **(76)**

TUNGSTEN-CARBIDE spray powder for hard facing with a Metco Thermospray gun is described in Metallizing Engineering Co., Inc. 4-page bulletin. **(77)**

CENTRALIZED CONTROL SYSTEMS, panelgraphs and panelboards designed by Panellit Div., Panellit, Inc. are presented in 15 pages. **(78)**

HARD FACING fact file on easy-to-read 3x5-in. reference cards is being maintained by Metal & Thermit Corp. Contains master card to indicate proper electrode or wire and data cards for each electrode listing helpful hints. **(79)**

HYDRAULIC JET CLEANERS in the Sellers Injector Corp. line are illustrated in an 8-page bulletin (424B). **(80)**

PLASTIC INSULATED and jacketed control cable rated 600 volts for many applications is detailed by Chester Cable Corp. in a 6-page data sheet. **(81)**

HEATING AND VENTILATING units in the Herman Nelson line of American Air Filter Co., Inc., are presented in a 20-page bulletin (910). **(82)**

E&MJ NOT GOOD AFTER JULY 1, 1959

Please send me the catalogs or further information about the items from New Products Digest whose numbers are circled. **JAN. 1959**

1	17	33	49	65	81	97
2	18	34	50	66	82	98
3	19	35	51	67	83	99
4	20	36	52	68	84	100
5	21	37	53	69	85	101
6	22	38	54	70	86	102
7	23	39	55	71	87	103
8	24	40	56	72	88	104
9	25	41	57	73	89	105
10	26	42	58	74	90	106
11	27	43	59	75	91	107
12	28	44	60	76	92	108
13	29	45	61	77	93	109
14	30	46	62	78	94	110
15	31	47	63	79	95	111
16	32	48	64	80	96	112

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8	24	40	56	72	88	104
9	25	41	57	73	89	105
10	26	42	58	74	90	106
11	27	43	59	75	91	107
12	28	44	60	76	92	108
13	29	45	61	77	93	109
14	30	46	62	78	94	110
15	31	47	63	79	95	111
16	32	48	64	80	96	112

Name .....

Title .....

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E&MJ NEW PRODUCTS DIGEST (*Continued*)

FUSIBLE PANELBOARDS—quick make, quick break in 30 through 1200 amp and 250 to 600 v design—are presented in Federal Pacific Electric Co. bulletin (3-230). 7pp. **(84)**

Metal and Mineral Processing

OSCILLATING CONVEYOR bulletin (2744) prepared by Link-Belt Co. describes the complete line of Flexmount, Coilmount and Torqmount conveyors in 24 pages. **(85)**

SILEX linings and pebbles through their hardness, toughness and low density can give you long service in your pebble mills according to R. Frere Evrard. Data sheets available. **(86)**

ENTOLETER IMPACT MILL breaks solids by throwing them with centrifugal force against rows of metal pins. Entoleter Div., Safety Industries, Inc. has installed many units in the fine grinding field. Check for literature. **(87)**

VIBRO ENERGY MILL being produced by William Boulton Ltd. is faster, more efficient for fine grinding and micronizing of wet or dry feeds. Check for literature. Tests show vibratory mill has three times capacity of ball mill on quartz. **(88)**

ROLL CRUSHER with hydraulic adjustment for final reduction has been developed by Pioneer Engineering according to literature available. Unit will take 4-in. feed. Model 4030 is available with two smooth shells. **(89)**

EASY-FLO bin device for control of bulk solids storage and conveying is illustrated in Fairmont Machinery Co.'s bulletin (BD958). 4pp. **(90)**

ELECTROSTATIC precipitators fitted with barbed-wire electrodes for better collecting are illustrated in Koppers Co., Inc. literature. **(91)**

FOG NOZZLE catalog showing the latest in fog spray nozzles is now available from Bete Fog Nozzle, Inc. **(92)**

SOLID-CONE SPRAY NOZZLES in the Schutte & Koerting Co. line are illustrated in a two-page flier. **(93)**

WHAT, WHERE, how and why draft effects the efficiency of combustion is detailed in a 19-page bulletin (58-S201) prepared by Hays Corp. **(94)**

HEAVY-DUTY limit switches for direct or alternating current applications are brought forth in a 16-page catalog (83) prepared by Micro Switch. **(95)**

BATCH WEIGHTING unit is discussed in Richardson Scale Co.'s two-page data sheet (5805) on the Richardson inventory counter and totalizer. **(96)**

LIGHTWEIGHT Spiralweld pipe, fitting, flanges and connections from Naylor Pipe Co. are presented in an 8-page condensed catalog. **(97)**

ROTARY POSITIVE pressure blowers and gas pumps used to solve air and gas handling problems are illustrated in Sutorbilt Corp.'s bulletin (S-59G) on their California series. **(98)**

FORCE BALANCE transmitters measure differential pressure and flow according to literature available from Bailey Meter Co. Specifications P21-7 and P22-2. **(99)**

Safety Items

SAFETY HATS made with reinforced laminated plastic are now available in the Skullgard line from Mine Safety Appliances Co. in nine different colors. 4pp. **(100)**

ARSINE DETECTOR kit developed by Mine Safety Appliances Co. is simple to operate, compact, portable and reliable, according to 4-page bulletin. **(101)**

VARIABLE DENSITY respirator filter—the Red Devil—is composed of two sections; a red prefilter to take out large particles and the filter body composed of microfine viscone, ninyon and asbestos, according to a two-page data sheet (S-8093) from American Optical Co. **(102)**

Steels and Alloys

ARCHITECTURAL PRODUCTS from Stran-Steel Corp. are listed in 23-page catalog. **(103)**

BRIEF FACTUAL data on Armco corrugated metal drainage structures is available in 6-page bulletin (CMS-10258) **(104)**

STAINLESS STEEL welding fittings and flanges are covered in Tube Turns' bulletin (TT 600). 53pp. **(105)**

ALUMINUM AND STEEL data booklet from Joseph T. Ryerson & Son, Inc. contains many helpful hints in 256 pages. **(106)**

HOW TO fabricate Hastelloy alloys is the subject of Haynes Stellite Co.'s 36-page bulletin on B, C, D and F alloys. **(107)**

For Sale

SAFETY DATA SHEET on phosphoric acid has been released by the Manufacturing Chemists Association, Inc. SD-70 may be obtained from the Association, 1625 Eye St., N. W., Washington 6, D. C. Price 30c.

COOLING TOWER TIPS and design information are available from Fluor Products Div., Fluor Corp., Whittier, Calif. in a special report that tabulates and evaluates weather conditions in 400 U.S. and foreign weather stations. Title is "Evaluated Weather Data for Heat Transfer Design." Price $35.

VERSATILE!

1 Mobile Drill now does all 4...

- ★ AUGER BORING
- ★ PERCUSSION DRILLING
- ★ SOIL SAMPLING
- ★ CORE DRILLING

the new, powerful

B-52 pacemaker

HYDRAULIC ROTARY DRILL

with the exclusive HOLLOW STEM AUGER... lets you sample while you bore!

time-saver no. 1

22′ TOWER—Permits withdrawal of rods in 20′ lengths. Mechanically operated, jackknifes to horizontal position for safe, legal highway travel.

time-saver no. 2

OFF-THE-HOLE HYDRAULIC BASE—Rail-mounted base slides out of way while adding or withdrawing drill sections, assures continuous perfect alignment. Hydraulically operated.

time-saver no. 3

CENTRALIZED 1-MAN CONTROL GROUPING—Located on operator's side of drill base, within easy reach. Fingertip controls plus advanced safety design increases operator's efficiency.

time-saver no. 4

NEW, *EXCLUSIVE* HOLLOW STEM AUGERS—Actually permit all types of sampling while you bore! Augers form their own casing, also allow coring through hollow stem after rock has been reached.

ONLY 4-in-1 RIG ON THE MARKET! ... Mobile Drill's new B-52 PACEMAKER brings unequalled versatility to contractors, prospectors, highway departments, soil sampling labs, aggregate producers and others who need greater drilling speed and flexibility. Here's a rugged, powerful, heavyweight workhorse that drives 5′ sectional augers to 150′ . . . N rods to 600′ . . . and A rods to 1,000′! New spindle type drive tube provides easy accessibility to both auger couplings and rod chucks, makes the B-52 a "quick change" artist in the field.

BIG POWER . . . BIG PERFORMANCE! PACEMAKER's twin hydraulic feed has fingertip control, gives up to *5 tons* (10,000 lbs.) hydraulic ram force! Rig has own independent power plant, variable speed control on rotary drive.

EQUAL TO 2 ORDINARY RIGS! Without the new PACEMAKER, you'll need at least two standard rigs to get the same number of jobs done! It can be operated by 1 man . . . seldom requires more than 2, even on the toughest jobs!

COMPACT, SELF-CONTAINED . . . a veritable traveling lab! You can put a man in the field almost indefinitely with this new, versatile drill. Contains built-in storage cabinets and racks for extra augers, drill stems and tools . . . lock-up chests for sampling equipment . . . everything to make it a highly mobile, fast-moving, time-saving unit! Mounts on 1 or 1½ ton vehicle.

MOBILE DRILL

WRITE FOR BULLETIN—TODAY!

For free illustrated folder and complete specifications on the new B-52 PACEMAKER, write

MOBILE DRILLING, INC.

Dept. 17, 960 N. Pennsylvania St.
Indianapolis 4, Indiana

From lightweight, jeep-mounted rigs to heavy-duty all purpose drills —MOBILE DRILL CAN MEET YOUR NEEDS! All drills mounted to your specifications.

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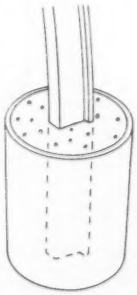
Questions

We've been asked about the Yieldable Arch

"What kind of base or footing should we use with the Yieldable Arch?"

If the bottom of your drift is definitely firm, you can set the Arches directly on the rock itself. Otherwise you should set them on footings. Wood blocks are frequently used for this purpose; so are short pieces of steel plates, channels, I-beams or other steel "leftovers."



If an acid water condition exists in your mine, it's well to set the Arch legs in concrete. A short length of pipe will serve as a permanent form in which to pour, as shown in the sketch.

SEND US YOUR QUESTIONS

You probably have other questions of a specific nature, concerning the application of the Yieldable Arch or Ring to your mine. If so, by all means send them in; we will study your questions and reply as promptly as possible. Write: Room 1041, Bethlehem Steel Company, Bethlehem, Pa.

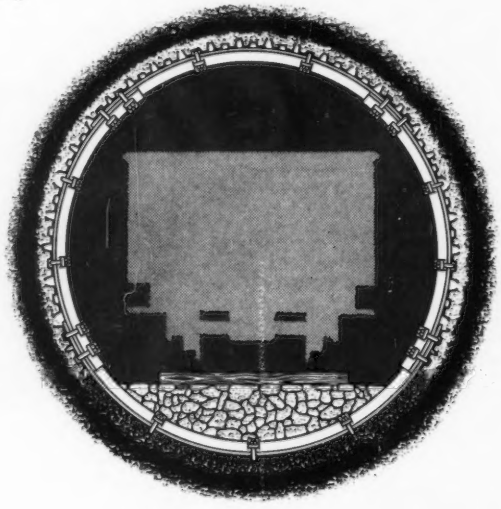
"Our mine opening has a heaving bottom. Is there any way the Yieldable Arch can help under that condition?"

For problems such as bottom heave, Bethlehem can furnish a four-piece yieldable set which is really not an arch but a Yieldable Ring, with four joints instead of the usual two found on the conventional Arch set.

The Yieldable Ring is essentially similar to the Yieldable Arch. It works on the same principle of sliding joints, is made of the same U-shaped sections, and is available for the same range of mine openings. It provides the best means of operating under pressures squeezing in from all directions.

Installation of the Yieldable Ring differs in that the two joints at the bottom of the ring should be tightened only to about 150 ft-lb, instead of the 180 ft-lb of torque normally applied. This is due to the fact that the bottom two joints usually will lie in muck, which adds measurably to the friction in the joint.

One more important point: with the Yieldable Ring, as with the Arch, lagging and blocking is necessary to fill the voids between steel and rock. Lagging should *completely surround* the Yieldable Ring.



BETHLEHEM STEEL COMPANY, BETLHEHEM, PA.

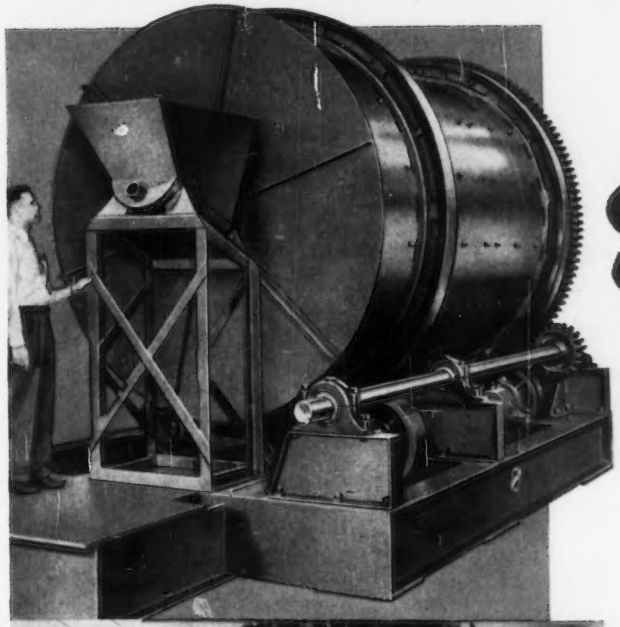
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corp. *Export Distributor:* Bethlehem Steel Export Corp.

BETHLEHEM STEEL

FOR CLEAN ORE—HIGH CAPACITY

TELSMITH

Super-Scrubbers®



● **high speed...terrific impact...grinding action much like a ball mill.** Ore travels from feed to discharge end against clean water flowing in the opposite direction —emerges clean—with clay and dirt disintegrated and carried away by the water.

low cost installation, operation and up-keep. Economical of water and power. The Telsmith Super-Scrubber is made in four sizes: 60-inch to 96-inch; with capacities of 50 to 250 tons per hour. Send for descriptive Bulletin 266.

Philippine Islands—this mill of **Baguio Gold Mining Company** is equipped with a 60-inch Telsmith Super Scrubber.

●

Minnesota—in the custom mill of **Skubic Bros.**, Virginia, Minn., a 96-inch Telsmith Super Scrubber turns out remarkably clean ore at minimum cost.

Min. 38

SMITH ENGINEERING WORKS

502 E. CAPITOL DRIVE **MILWAUKEE 1, WISCONSIN**

Representatives in Principal Cities in All Parts of the World • Cable Address: Sengworks, Milwaukee

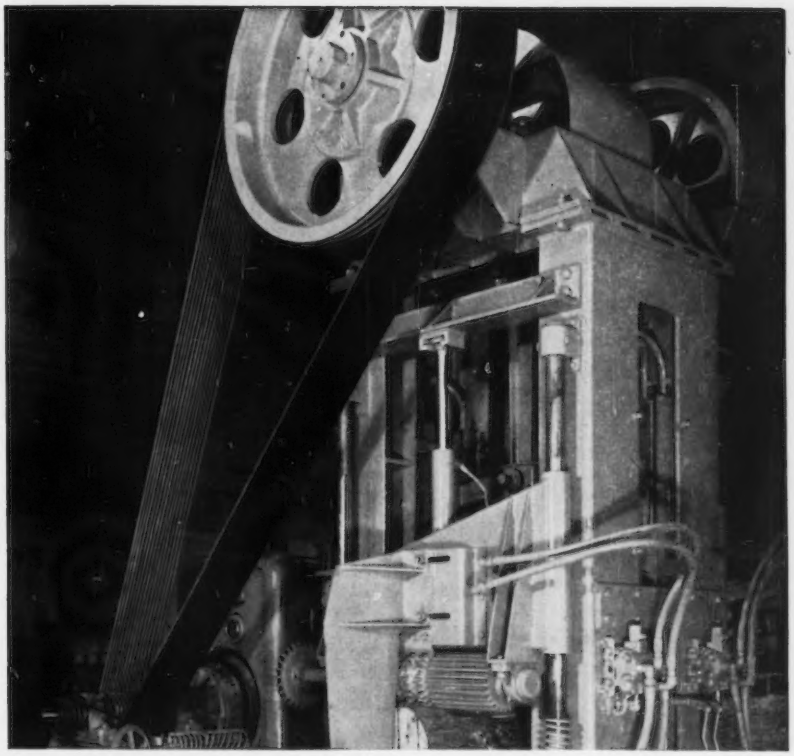
It's the Last Third of an R/M Conveyor Belt that Gives

. . . "More Use ~~per~~ for Your Dollar"

R/M engineers recognize that *every* belt feature — troughability, resiliency, fastener-holding ability, strength member fabric, cover toughness and thickness — all help to determine the true cost of conveyor belt on your job. That's why each component part of Ray-Man Conveyor Belt is precision proportioned to assure better belt balance where it pays off most for you — in *longer* — ⅓ longer — belt service life! These features make the difference!

- Trains Naturally — Handles Fuller Loads
- Resists Impact and Ripping — Takes Abusive Loads
- Double Compensation — Relieves Outer Ply Stress — Flexible
- Holds Fasteners — Requires No Breaker Ply
- Exclusive "XDC" Cover—Protects against Wear, Tear, Cuts and Abrasion
- Moisture and Mildew Resistant

Extra cushioned Homocord and rugged R/M Tension-Master also give you longer belt service life. Write for Catalog 25 CB.



R/M POLY-V® DRIVE— New, patented heavy duty Poly-V* Drive delivers up to 50% more power in the same space as multiple V-drive . . . or equal power in as little as ⅔ the space. Single unit belt design eliminates multiple V-belt "length matching" problems. More constant speed ratios, less wear on belt and sheaves, smoother running. Write for Bulletin #6638.

HOMOFLEX HOSE— Light, strong, "flexible as a rope" . . . easiest handling hose made for air, water, other fluids and gases. Mandrel-made *without* pre-set twist. Resists kinking, coils and uncoils freely in *any* direction. Homogeneous tube-to-cover bond; never any separation. Uniform inside and outside diameters for easy coupling. Write for Bulletin #6879.

Courtesy of the Ingalls Shipbuilding Corporation

TRAINS NATURALLY

DOUBLE COMPENSATION RELIEVES OUTER PLY STRESSES

*Poly-V is a registered Raybestos-Manhattan trademark.

RMB03

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MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products: Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

These are the profit-proven that lead to Payhauler® fleet

Look into the rock-lugging, grade-beating 24-ton "95"...

- **Bonus-powered,** with a 335 hp high-torque turbo charged diesel engine to beat steep grades and high altitudes with full payloads!
- **Your choice of torque converter** with powershift, or 9-speed constant mesh transmission. Speeds to match every load and road.
- **Shock-cushioning** of planetary drive axles.
- **Massive frame stamina**—with 277 lbs. of high-strength, shock-resisting steel for each rated ton of carrying capacity.
- **Springs with extra leaves** and **extra length** to cushion the payload, smooth the ride.
- **Positive power-steering, Torqmatic braking,** panoramic vision, for unmatched operating ease and load-speeding safety.
- **Up to 25% higher hauling speeds**—the "95" can highball, fully loaded, up to 38 mph.
- **Faster reverse speeds**—for spotting to load, or positioning full loads for dumping. The gear-drive "95" can travel up to 7.1 mph. in reverse.
- **9-second dumping**—another cycle-speeding feature.

...and the 250-hp, 18-ton "65" has equally outstanding features.

International® Construction Equipment

International Harvester Co.
180 North Michigan Ave., Chicago 1, Illinois

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors... Self-Propelled Scrapers and Bottom Dump Wagons... Crawler and Rubber-Tired Loaders... Off-Highway Haulers... Diesel and Carbureted Engines... Motor Trucks... Farm Tractors and Equipment.

Power for steep grade climb-outs wins steady job for five "65's"

Bonus Turbo Charged Diesel power to deliver extra-tonnage loads up a haul road with a 17% average grade accounts for the dependence of Caldwell Engineers on five "65" Payhaulers—on the $13 million hydro and flood-control Oliver Dam, Columbus, Ga.

Contractor doubles load delivery speed with positive Torqmatic braking!

Central Pennsylvania Quarry and Stripping Co. credits *Torqmatic braking* of their 5-unit "95" Payhauler fleet with doubling load delivery speed—by increasing safe downhill hauling speeds! They've compared "95's" directly to other off-road equipment on rock-hauling duty!

features ownership!

Prove what it means to command the Payhauler ratio of power to payload—for hauling up to 25% faster; beating grades and altitude. Try Payhauler "pick-up-truck" spotting ease—"zip-around" power steering—exclusive high reverse—and all the other Payhauler advantages. See your International Construction Equipment Distributor for a demonstration!

High-percentage availability proves inbuilt stand-up-ability!

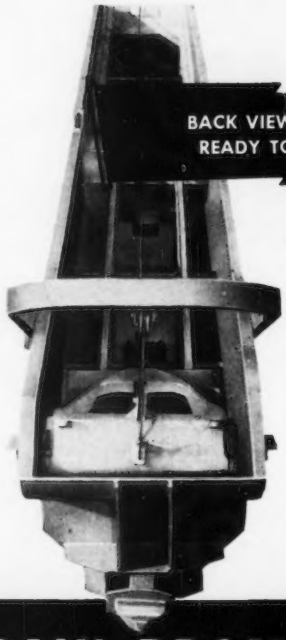
98.5 work availability through one measured 12-week period is the mark set by a 10-unit "95" Payhauler fleet—high-balling rock over steep High Sierra grades, on mammoth Pool Hydro Project, for Southern California Edison Co. Such records result from reserve power, reserve frame and transmission strength, and reserve shock-resistance!

Another thirty "95" Payhaulers join Merritt-Chapman and Scott fleet!

Merritt-Chapman and Scott Corporation has added thirty more "95" Payhaulers to their Niagara Power project equipment spread. Now, the M-C and S Payhauler fleet totals 62 units—largest in the world! On St. Lawrence Seaway, huge Glen Canyon dam, and Niagara Power Project, M-C and S have proved rock-lugging, grade-beating Payhauler performance—and confirmed their satisfaction with repeat orders.

BACK VIEW SCRAPER READY TO MAKE DOWN-STROKE

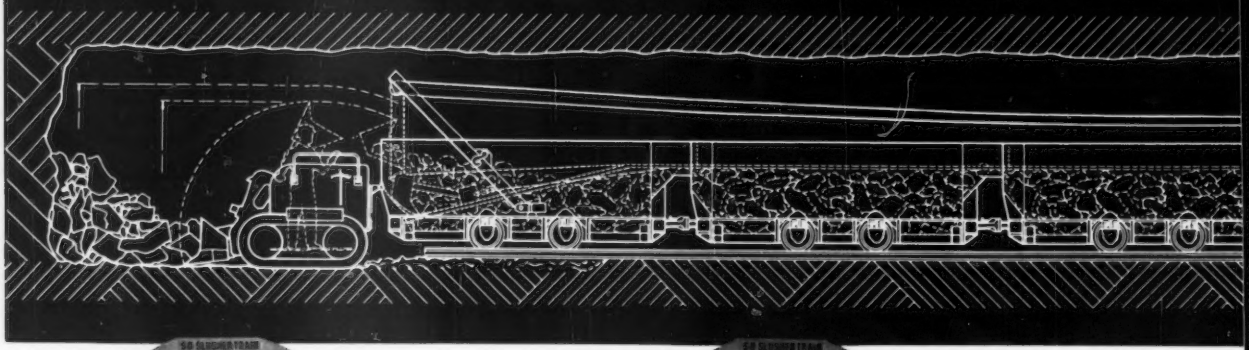
- **NO CAR SWITCHING! S-D Slusher-Train's self-contained scraper loads each car progressively in-train!**
- **NON-STOP DUMPING of entire trip because S-D Automatic Bottom Dumping Cars in S-D Slusher-Train dump one-after-another while moving over bin or dump.**



BACK VIEW SCRAPER READY TO SLUSH-OUT

- **After drift work is completed, S-D Slusher-Train can be converted to regular production work . . . and you have Sanford-Day's exclusive "Overlapping Ends," making it possible to load without spillage between-cars when loading under chutes or conveyors into one car, then another!**

WHY S-D SLUSHER-TRAIN PROMISES YOU

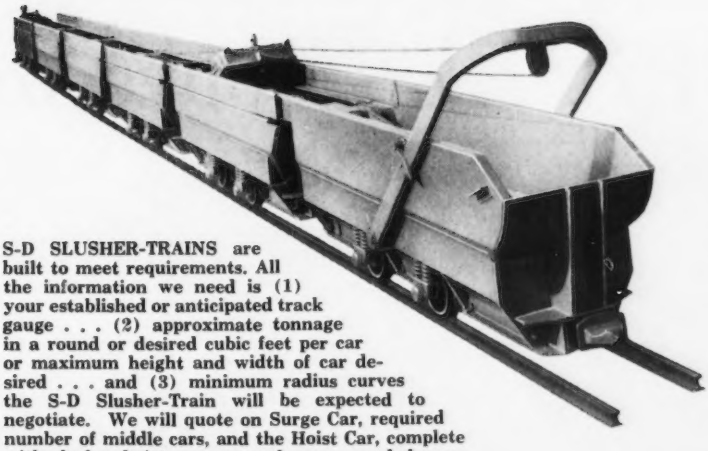


FRONT VIEW SCRAPER READY TO MAKE DOWN-STROKE

- **MINIMUM EQUIPMENT — only a loader, S-D Slusher-Train and a locomotive!**
- **MINIMUM MANPOWER — two men only . . . loader operator and S-D Slusher-Train operator (who is motorman when train is in transit).**

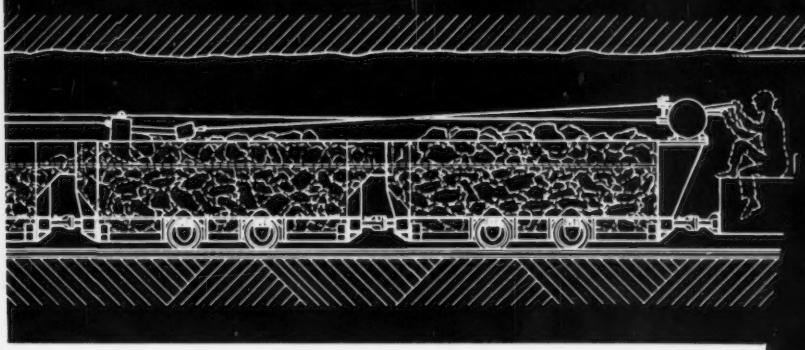
FRONT VIEW SCRAPER READY TO SLUSH-OUT

- **HIGH SPEED — There is no method that can match the S-D Slusher-Train in speed (you can easily figure on mucking out 1 to 1½ tons a minute). The "high-ball-it" speed and safety will save you days . . . perhaps weeks in completing drift or tunnel work! This means minimum cost!**

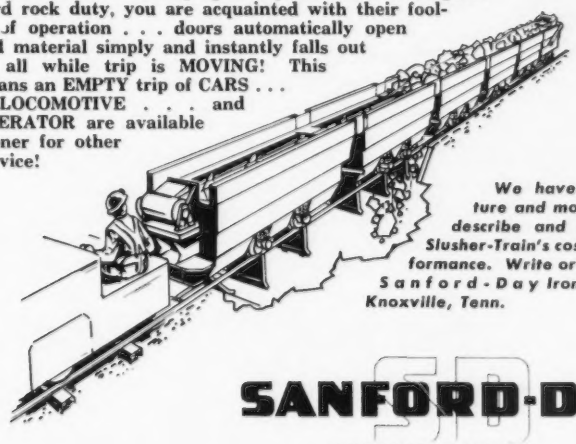


S-D SLUSHER-TRAINS are built to meet requirements. All the information we need is (1) your established or anticipated track gauge . . . (2) approximate tonnage in a round or desired cubic feet per car or maximum height and width of car desired . . . and (3) minimum radius curves the S-D Slusher-Train will be expected to negotiate. We will quote on Surge Car, required number of middle cars, and the Hoist Car, complete with slusher hoist, scraper and recommended rope.

TREMENDOUS SAVINGS!



The bulk of your cost savings will undoubtedly be earned in the MINIMUM TIME S-D Slusher-Train requires to load-out a round, which is due to more efficient use of equipment and manpower. Add to this MINIMUM DUMPING TIME! If you have seen S-D Automatic Bottom Dumping Cars perform in the toughest hard rock duty, you are acquainted with their foolproof operation . . . doors automatically open and material simply and instantly falls out — all while trip is MOVING! This means an EMPTY trip of CARS . . . a LOCOMOTIVE . . . and OPERATOR are available sooner for other service!



We have both literature and movies that will describe and show S-D Slusher-Train's cost-saving performance. Write or call us today. Sanford-Day Iron Works, Inc., Knoxville, Tenn.

SANFORD-DAY

KNOXVILLE, TENNESSEE

See the NEW McNally Pittsburg "SHORTY" Belt Conveyor

—that increases belt life, slashes maintenance cost!

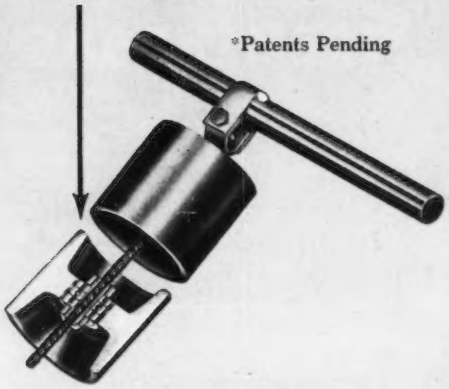
The "Shorty" unit is only 2 feet high!

The new "Shorty" underground conveyor featuring the new McNally Pittsburg Cradle Idler is ideally suited for use in limited working areas. Vertical supports are only 2 feet high. For extremely low clearance installations these conveyors can be made with 3″ diameter rollers (instead of the standard 5″), and the average over-all height can be as little as 17″ for a 36″ belt, using a 30° deep trough idler construction.

For "Do-it-yourself" construction, the H-frames and stringers (which may be either wire rope or pipe stringers) are shipped disassembled and may be assembled in the field to fit any conveyor length necessary. It is only necessary to cut the stringers to the desired length, attach the Cradle Idlers and H-frames, and your conveyors are ready for operation.

Exclusive NEW Patented Cradle Idler*

*Patents Pending



The secret of the dramatically improved performance and lower maintenance cost of this new heavy duty conveyor is the *true catenary suspension* of the Cradle Idlers. Since the rollers *rotate* on the steel rope, dangerous "loping and harmonics" cannot develop. The 5" rubber rollers, assembled on precision ground ball bearings, are prelubricated, lifetime sealed.

- Increased belt life—because full belt support is maintained under all conditions
- No creasing or cutting of belt
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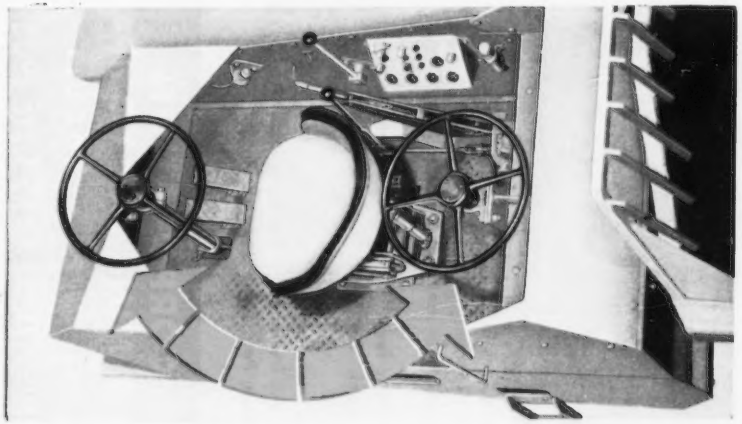

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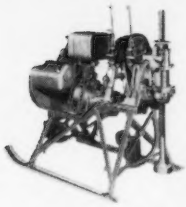

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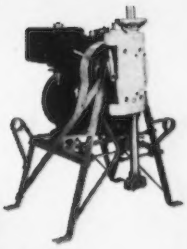
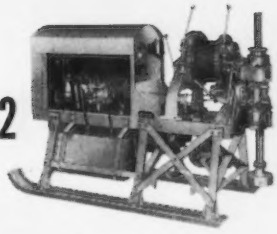


x-ray

Compact, portable—185 lbs. net. Takes ¾" or ⅞" core to 200 ft. Low fuel consumption.



BBS-2

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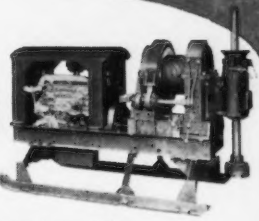

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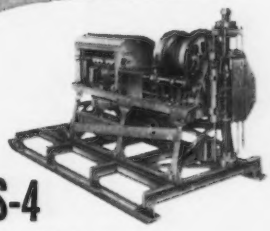

BBS-4

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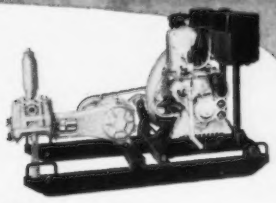

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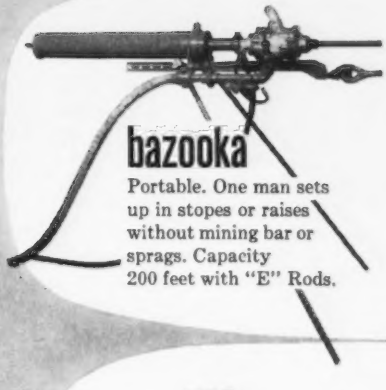

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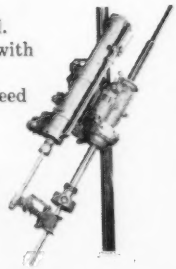
4 feed swivelhead. Capacity 800 ft. with "E" Rods. JVR with right-hand feed screw for blastholes.



BBU-2

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ENGINEERING AND
MINING JOURNAL

JANUARY 1959

What's Ahead for 1959—and Beyond

THE COMING YEAR should be a more prosperous one than 1958 for mining and industry in general. At least this is what a sizeable stack of year-end reports by company officers, economists, business reporters and analysts indicates. Here are some examples:

Chairman Melvin Baker, of National Gypsum Co. estimates that housing starts will climb from an impressive total of 1.15-million units in 1958 to 1.2-million in 1959. Total construction expenditures, he estimates, will establish a $49-billion high for 1958, and rise to another record high of $52.3-billion for 1959. McGraw-Hill Department of Economics parallels these figures with the following total construction expenditures by government and industry: 1957, $48.1-billion; 1958, $48.8-billion; and 1959, $52.0-billion. The 1959 estimate was prepared with the assistance of Robinson Newcomb, a leading economic consultant in the construction field.

In the steel industry, Max D. Howell, executive vice president of American Iron and Steel Institute, expects the present uptrend in iron and steel production to continue during 1959, and that the new year's output of ingots and steel for castings will be 100- to 110-million net tons. This compares with about 85-million net tons for 1958. Joseph L. Block, president of Inland Steel Co., estimates that total ingot production in 1959 will be 110- to 116-million tons. Both estimates preclude any serious unforeseen production interruptions.

Mr. Block also noted that "well-informed forecasters in the automobile industry are predicting a minimum of 5½-million cars for 1959, an increase of 30% over the 4¼-million cars estimated for 1958."

In a December E&MJ survey of the outlook for metal and nonmetallic mineral sales for 1959, to which nearly all major producers contributed opinions, 70% of the nonferrous metal producers expected better sales during 1959. Range of increase was 8 to 30%, with an average expected increase of about 18%. Nonmetallic mineral producers expect 1959 sales to exceed 1958 sales by about 15%. Iron ore companies who reported, estimated that 1959 sales would be up 10 to 20%.

Capital expenditures for industry, always regarded as a reliable indicator of business trends, appear to be reversing a downtrend from an abnormally high year in 1957. Returns of questionnaires sent to major mining companies by E&MJ indicate that the downtrend in capital expenditures by U.S. mining companies domestically and abroad may be reversed by the end of 1959.

But welcome as this infusion of optimism in outlook may be, we couldn't help but note an undertone of anxiety in some of the long-range appraisals of the future. To put it bluntly, it appears that in 1959 and beyond, industry, labor and government are going to have to revise traditional patterns to combat stiffening competition in a rapidly changing economic world.

To illustrate, Roger M. Blough, chairman of United States Steel Co., predicts that the U.S. "must face up to the probable fact" that it will no longer maintain its predominate role in steel production and over-all industrial production because of rapid inroads of world competition.

Referring to foreign competition, Mr. Blough stressed, ". . . . no one should underestimate either the quality of those machines or the aptitude of their operators." U.S. industry is "only in the first skirmishes of a world-wide battle of production that is destined to rage for many decade to come," he said.

Will industry lose this battle of production? It could, says Mr. Blough, if federal taxes make it impossible for companies to buy new and better tools for production. It could, if our labor leaders "inveigh against corporate profits—and if they force uneconomic wage increases that are 'costing' American products out of markets at home and abroad, and American workmen out of jobs." It could, he concludes, "if our government does not revise the depreciation provision of our tax laws, *as the governments of almost all other leading industrial nations of the world have done.*"

Thus it appears that the "easy market" days of U.S. industry and labor are nearing an end—"easy market" days when our major competition came from industrial centers bombed out, bankrupted, or plagued with political and economic upset and instability. From now on industry, labor and government will have to regard each other as partners in a competitive battle for markets, or U.S. industry and labor may well lose the coming "battle of production."

Maintenance in 1959

IN A PERIOD OF INCREASING COSTS and lowering prices, such as the one being experienced by most of the mining industry at the present time, greater and greater emphasis is being put upon cost cutting and increased efficiency.

This issue of *E&MJ* contains a selection of articles on maintenance practices at several mines in the U. S., and two pieces on recommended maintenance techniques by manufacturers. The report is broken up into two parts:

Section I includes an eight-page article on basic welding problems and some solutions. Your own maintenance crew can save time and money with the information available in Mr. Kolb's article, which was originally presented at the Ninth Plant Maintenance and Engineering Conference, held in Chicago, January 1958.

A full page on recommended equipment and practices for sharpening and maintaining drill bits is the second part of Section I, to be found on p 79.

Section II consists of two case histories of maintenance practice, at Bunker Hill Co. and at Carey Salt Co. The emphasis in the latter is on preventive maintenance through keeping of accurate records and study of equipment history for guidance of future procedures (p 95).

At Bunker Hill, the combination of an alert maintenance team and an extremely resourceful machine shop has delivered considerable savings. With the company's permission, *E&MJ* is able to discuss costs, breakdowns and maintenance savings in a number of specific cases involving haulage, hoisting, pumping and ore production. It starts on p 94.

The following is a list of other articles on the subject which have appeared in *E&MJ* over the past year, and which cover many of the areas not discussed in this report.

March 1958:	Berkeley Pit plans a maintenance area for greater efficiency	110
May 1958:	General Electric Co. opens eleven shops for "drive-in" locomotive repair	41
June 1958:	Crusher repairs were greatly simplified with installation of a work platform	94
	Flue-gas corrosion at Cominco's Trail was cut with lead lining of sections	104
July 1958:	Study of conveyor belt failures and proper repair can save replacement cost	94
September 1958:	Proper lubrication techniques can extend the life of induction motor bearings	112
October 1958:	In one of the most constructive contributions to industry efficiency in recent years, Bagdad Copper Co. gave *E&MJ* the full story on its haulage and maintenance costs and record keeping technique	112
November 1958:	A basic part of maintenance is knowing when a piece of equipment should be replaced and not repaired. The METRE method gave the particulars	102
December 1958:	Prevention of screen blinding was discussed by an expert	102

Further information on the particulars of hard-surfacing, lubrication, servicing, etc. may be obtained every month in the For Your Files section of the New Products Digest, and in various Operating Ideas, which are also published monthly in *E&MJ*.

WHAT IS the base metal? Does the geometry of the part to be welded present any problem? What welding process should you use? What size and type of electrode or filler metal is needed? The author attempts to answer all these, and other problems.

How to Do a Better Welding Job

RAY KOLB

WELDING NEED NOT BE a hit-or-miss proposition. Knowing the answers to a few simple questions can help you guide your maintenance crew to do a better job. What is the base metal? Does the thickness or geometry of the part to be welded present any problem? What welding process should you use? What size and type of electrode or filler metal is needed? What welding procedure should you use? Who's going to do the job?

Let's take each of these questions separately and see what you should know about the problems encountered in every welding job.

What Is the Base Metal to Be Welded?

It pays big dividends to keep accurate material records of the parts in your plant that may some day require welding. These records can best be obtained at the time equipment is purchased or built. One must be careful, however, to avoid ambiguous descriptions such as "stainless steel," "brass," "aluminum," or "alloy steel." Many different types fall into each of these broad classifications. Practically all of these metals can be welded if their composition is known, but can cause considerable difficulty if we must guess what material we are welding.

For example, the occasion might arise requiring a repair weld on a part known only as stainless steel. It could be any one of many types, varying from a readily weldable material like Type 304 (18% Cr, 8% Ni) to a difficult-to-weld, air hardenable material like Type 430 (12% Cr, over 0.15% C).

It is a great temptation when materials of unknown composition are encountered to turn the job over to a welder and let him worry about it. Percentage-wise, however, we will encounter fewer weld failures if we can tell the welder what material he is going to weld as well as the proper welding procedures and filler material.

To get an accurate metal identification would require a spectrographic or a quantitative chemical analysis. However, such analyses are expensive and usually it is not practical to wait long enough for such an analysis.

There are a few simple tests, however, that can give us some idea of the metal composition.

Shape, weight, color and scale or rust formation on a part gives us our first clues as to composition. By the shape of a part we can differentiate between castings, forgings, extrusion, plate, pipe, etc. Since we have a general idea as to what materials are used to make parts of this type, we have a start. Weight allows us to differentiate between the light materials such as aluminum and magnesium and the iron and steel materials. Color characterizes most

Mr. Kolb is head foreman, welding shop, Whiting Refinery, Standard Oil Co. (Indiana), Whiting, Indiana. His paper was given originally at the 9th Plant Maintenance & Engineering Conference, held concurrently with the 9th Plant Maintenance & Engineering Show, Chicago, Ill., January 1958. Copyright 1958 © by Clapp & Poliak, Inc., New York City.

Simple Tests for Identifying Metals by

	White Cast Iron°	Gray Cast Iron	Malleable* Iron	Wrought Iron	Low-Carbon Steel and Cast Steel	High-Carbon Steel
APPEARANCE						
Fracture	Very fine silvery white silky crystalline formation	Dark gray	Dark gray	Bright gray	Bright gray	Very light gray
Unfinished Surface	Evidence of sand mold; dull gray	Evidence of sand mold; very dull gray	Evidence of sand mold; dull gray	Light gray, smooth	Dark gray; forging marks may be noticeable; cast-evidences of mold	Dark gray; rolling or forging lines may be noticeable
Newly Machined Surface	Rarely machined	Fairly smooth; light gray	Smooth surface; light gray	Very smooth surface; light gray	Very smooth; bright gray	Very smooth; bright gray
CHIP TEST						
Appearance	Small broken fragments	Small, partially broken chips but possible to chip a fairly smooth groove	Chips do not break short as in cast iron	Smooth edges where cut	Smooth edges where cut	Fine grain fracture; edges lighter in color than low-carbon steel
Size		⅛ in.	¼–⅜ in.	Can be continuous if desired	Can be continuous if desired	Can be continuous if desired
Facility of Chipping	Brittleness prevents chipping a path with smooth sides	Not easy to chip because chips break off from base metal	Very tough therefore harder to chip than cast iron	Soft and easily cut or chipped	Easily cut or chipped	Metal is usually very hard but can be chipped
BLOWPIPE TEST						
Speed of Melting (From cold state)	Moderate	Moderate	Moderate	Fast	Fast	Fast
Color Change While Heating	Becomes dull red before melting	Becomes dull red before melting	Becomes red before melting	Becomes bright red before melting	Becomes bright red before melting	Becomes bright red before melting
Appearance of Slag	A medium film develops	A thick film develops	A medium film develops	Oily or greasy appearance with white lines	Similar to molten metal	Similar to molten metal
Action of Slag	Quiet; tough, but can be broken up	Quiet; tough, but possible to break it up	Quiet; tough, but can be broken	Quiet; easily broken up	Quiet	Quiet
Appearance of Molten Puddle	Fluid and watery; reddish white	Fluid and watery; reddish white	Fluid and watery; straw color	Liquid; straw color	Liquid; straw color	Lighter than low-carbon steel; has a cellular appearance
Action of Molten Puddle Under Blowpipe Flame	Quiet; no sparks; depression under flame disappears when flame is removed	Quiet; no sparks; depression under flame disappears when flame is removed	Boils and leaves blowholes; surface metal sparks; interior does not	Does not get viscous; generally quiet; may be slight tendency to spark	Molten metal sparks	Sparks more freely than low-carbon steel

°Very seldom used commercially.
*Malleable iron should always be bronze-welded.

**Alloy steels vary so much in composition and consequently in results of tests that experience is the best solution to identification problems.

copper-base alloys. Scale and rust formation frequently segregate the plain carbon or low alloy steels from the stainless types or the high nickel copper alloys.

Spark testing can often be helpful. Iron base or ferrous materials throw off a characteristic spark stream when held against a grinding wheel, while the non-ferrous materials such as copper, aluminum, and nickel-base do not yield any appreciable spark. Testing is best done in a shaded area where the color can easily be seen.

A medium or small grained grinding wheel turning at ordinary speeds gives a satisfactory spark. Best results are obtained by comparing the spark from the unknown material with known samples. Care must be taken to use the same speed and contact pressure since the length of the stream will vary if either is changed. Welding rod is a

Appearance, Chip Test, and Blowpipe Test†††

Alloy** Steel	Copper	Brass and Bronze	Aluminum and Alloys†	"Monel" Metal	Nickel	Lead††	Magnesium
Medium gray	Red color	Red to yellow	White	Light gray	Almost white	White; crystalline	White
Dark gray; relatively rough; rolling or forging lines may be noticeable	Various degrees of reddish brown to green due to oxides; smooth	Various shades of green, brown, or yellow due to oxides; smooth	Evidences of mold or rolls; very light gray	Smooth; dark gray	Smooth; dark gray	Smooth; velvety; white to gray	Evidences of mold or rolls; very light gray
Very smooth; bright gray	Bright copper red color dulls with time	Red through to whitish yellow; very smooth	Smooth; very white	Very smooth; light gray	Very smooth; white	Very smooth; white	Smooth; very white
**	Smooth chips; saw edges where cut	Smooth chips; saw edges where cut	Smooth chips; saw edges where cut	Smooth edges	Smooth edges	Any shaped chip can be secured because of softness	Rough chips; saw edges where cut
**	Can be continuous if desired	Can be continuous if desired	Can be continuous if desired	Can be continuous if desired	Can be continuous if desired	Can be continuous if desired	1/16 to 1/8 in.
**	Very easily cut	Easily cut; more brittle than copper	Very easily cut	Chips easily	Chips easily	Chips so easily it can be cut with penknife	Very easily cut
**	Slow	Moderate to fast	Faster than steel	Slower than steel	Slower than steel	Very fast	Faster than steel
**	May turn black and then red; copper color may become more intense	Becomes noticeably red before melting	No apparent change in color	Becomes red before melting	Becomes red before melting	No apparent change	No apparent change in color
**	So little slag that it is hardly noticeable	Various quantities of white fumes, though bronze may not have any	Stiff black scum	Gray scum; considerable amounts	Gray scum; less slag than "Monel" Metal	Dull gray coating	Dirty gray scum
**	Quiet	Appears as fumes	Quiet	Quiet; hard to break	Quiet; hard to break	Quiet	Quiet
**	Has mirrorlike surface directly under flame	Liquid	Same color as unheated metal; very fluid under slag	Fluid under slag	Fluid under slag film	White and fluid under slag	Same color as unheated metal; very fluid under slag
**	Tendency to bubble; puddle solidifies slowly and may sink slightly	Like drops of water; with oxidizing flame will bubble	Quiet	Quiet	Quiet	Quiet; may boil if too hot	Quiet

†Due to white or light color and extremely light weight aluminum is usually easily distinguishable from all other metals; aluminum alloys are usually harder and slightly darker in color than pure aluminum.

††Weight, softness, and great ductility are distinguishing characteristics of lead.

†††Reproduced from *Linde Tips* by permission of Linde Air Co., division of Union Carbide Corp. This table was not part of M. Kolb's original paper.

source of sample material, but care must be taken in using coated electrodes as a comparison metal, since alloying agents are frequently added through the coating. Spark testing charts are included in most handbooks and steel suppliers' catalogs.

A magnet helps us in identification, by separating materials into three groups. See table No. 1.

The magnet test has special significance with stainless steel identification, since the nonmagnetic or slightly magnetic materials require no preheat or stress relieving, while those that are magnetic do require it.

A nitric acid spot test is another way to get some idea of composition. A drop will not affect stainless steel or stainless iron but will produce a green or blue-green color

Table No. 1—Magnetic Detection

Group I—Strongly Magnetic

1 Carbon and low alloy steels
2 Wrought iron
3 Cast iron
4 Pure nickel
5 Stainless irons (under 17% chrome)

Group II—Slightly Magnetic

1 Stainless steel (18-8 types when cold worked)
2 Monel
3 High nickel alloys

Group III—Nonmagnetic

1 Stainless steel (18-8 type annealed)
2 Copper base alloys
3 Aluminum base alloys
4 Zinc base alloys

with Monel or copper-nickel and a brown color with low-carbon steel.

Chisel testing is frequently used to determine if a part is made of gray cast iron, malleable iron, or steel. This identification can readily be made with a sharp-edged chisel and a hammer. By trying to cut a continuous chip (not over 1/16 in. thick) we can tell which of these metals is involved. With cast iron it is not possible to obtain a continuous chip, as it keeps breaking. In the case of malleable iron a short, slightly curved chip is obtained. It is difficult to obtain chips longer than ½ in. with malleable iron. However, if the piece tested is steel, a continuous curled chip over ½ in. long can be obtained.

It must be emphasized again that the easiest way to know what metal you are welding is to keep accurate records from the time equipment is installed. The tests listed above give us some idea of what materials we have to weld, but they do not give us an accurate analysis.

How Does the Thickness or Geometry Of the Part Affect Welding?

Even with easy-to-weld materials, such as low-carbon steel, problems arise when the part becomes too thick or too thin. In depositing heavy welds (over ¾ in. thick), preheating and stress relieving becomes desirable. In welding light gage sheet steel, burning through becomes a problem. Close fit-up, clamping the joint down tight and the use of a copper backing assist in accomplishing the job. It is a good practice to review carefully work that is over ¾ in. thick or under 3/32 in., rather than leave the problem completely to the welder.

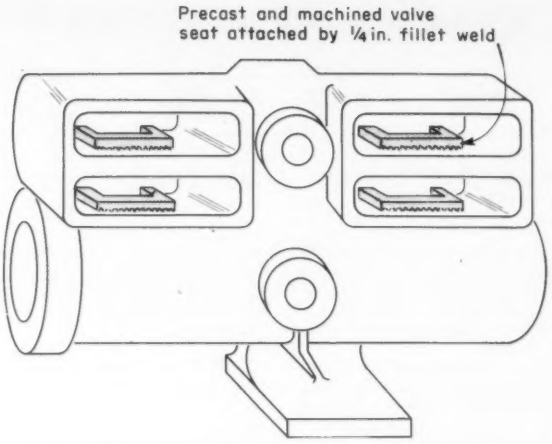


FIG. 1—Attaching pre-cast and machined valve seats can be installed in a valve by a fillet weld all the way around.

Accessibility to the area to be welded can be a major factor. An example is the building up of valve seats, inside a pump, that can be reached only through a small opening. Welding of this type is difficult and time consuming. There have been cases on steel pumps where it is more economical to cut out a portion of the casting above the valve seats to permit accessibility and then weld this piece back in after the valve seats have been repaired. Fig. 1 shows a method by which pre-cast and machined valve seats were installed in brass pump bodies. Attaching this seat by means of fillet weld all the way around saved considerable welder time and discomfort. Previously the seats had been completely built up by acetylene welding, under preheated conditions.

Geometry of a welding joint design can have considerable bearing on the success of the job. As a general rule, the type of joint most desired is the one that will permit satisfactory welding at a minimum cost. Pipe under ¾ in. in thickness is usually welded with the type of bevel shown

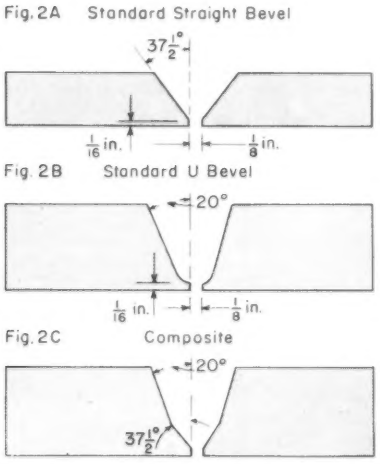
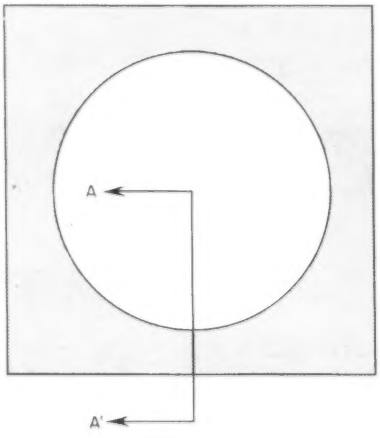


FIG. 2A, 2B and 2C—Geometry of the welding joint design can have considerable bearing on the success of the job.



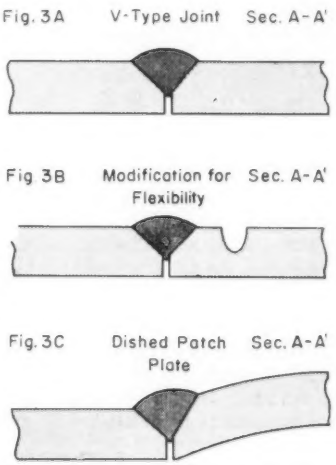


FIG. 3A, 3B and 3C—One of the most rigid types of joint encountered in welding is a circular patch in heavy stock.

in Fig. 2A. It consists of a 60 or 75 deg included angle and a ⅛ in. land. This joint is simple to prepare, either by flame cutting or machining. Where thicknesses are greater than ¾ in. the joint becomes much wider than is needed for accessibility and it requires considerable time to weld. To reduce welding time on heavier walled pipe, the type of joint design shown in Fig. 2B is used. The thin section at the root of this joint gives some difficulty with burn-through when arc welding. The difficulty is not encountered when using the joint shown in Fig. 2A and has led to the compromise shown in Fig. 2C, which is very popular for heavy-walled pipe welding.

In chipping or gouging out cracks to be repair-welded by electric welding, care must be exercised to get a proper sized groove. It must provide accessibility; however, if it is too big, not only is more welding time required, but the possibility of cracking and/or distortion is increased. A sheet metal template, made to the contour of the groove shown in Fig. 2B, is a handy guide in providing a proper joint for this type of work.

Rigidity is the source of much welding difficulty. The expansion forces resulting from the heat of welding and the contraction forces associated with the solidification of the molten weld metal can cause cracking in the weld or base metal. In some cases joint design can eliminate this problem.

Fig. 3A shows one of the most rigid types of joints encountered in welding. It is essentially a circular patch being welded into heavy stock. The first pass in such a weld is subject to extreme stresses when it contracts upon solidification. The relatively small cross section of weld area must resist these forces. A heavy first pass has the best chance of resisting these forces and, of course, preheat will be greatly beneficial.

Sometimes a weld of this type is used primarily for obtaining a fluid-tight seal, and strength of the joint is not a major factor. Relieving one or both sides of the joint as shown in Fig. 3B, or using a dished patch plate as in Fig. 3C, may provide the needed flexibility in such cases.

Which Welding Process Should Be Used?

Manual electric arc welding with coated electrodes, and oxyacetylene welding, are the two most widely used processes in maintenance. Because both have been extensively used for many years, no attempt will be made to describe these familiar processes; however, electrodes and welding rods will be discussed later.

Tungsten inert gas welding has been the key to the successful solution of many difficult maintenance welding problems. In some ways this process can be considered a combination of electric arc and gas welding. The heat source comes from an electric arc maintained between a tungsten electrode (which is practically non-consumable) and the work.

Inert gas (argon or helium) is directed by a concentric nozzle around the tungsten electrode so that it protects the electrode, the arc stream, and the molten weld pool from the harmful effects of nitrogen or oxygen in the air. This process has been very effective in welding aluminum, magnesium, light gage sheet steel, and in putting high quality root passes in critical piping.

Metal inert gas welding uses inert gas to protect the arc zone in the same manner as in tungsten inert gas welding. However, the arc itself is maintained directly between the filler metal and the work. Automatic controls feed the filler metal from a coil at such a rate as to give proper welding conditions. Metal inert gas welding may be used either semi-automatically, where the welder holds the welding gun in his hand and manually imparts the forward motion, or fully automatically, where the gun is mounted and the welding speed is mechanically imparted.

Aluminum, brass and stainless steel are readily welded with this process, using either helium or argon as a shielding gas. Carbon dioxide is proving successful as a low cost shielding gas for carbon steel welding. While thoroughly killed bare filler wire makes satisfactory welds, there are modifications of this process which use flux in addition to the carbon dioxide.

One process utilizes a hollow flux-filled filler wire, while another utilizes a powdered magnetic flux which is injected with the carbon dioxide stream and coats the electrode as it approaches the arc zone.

Submerged arc welding uses a granular type flux to protect the arc zone in much the same manner as inert gas does in the metal inert gas welding process. This flux hides the arc from view and the operator does not require a welding helmet.

It is used both semi- and fully automatically. The granular flux melts from the heat of welding and leaves the weld covered with a glass-like coating which is readily removed. This process is limited to welding in positions where the granular flux remains in place due to gravity alone or where suitable dams can be built to retain it.

It has found extensive use in pressure vessel fabrication and repair and has found economical use in fabricating pipe as small as 6 in. nominal pipe size. It can be used on low and medium carbon steels and on most alloys.

Metallizing has established itself as a highly dependable maintenance tool when properly applied. Probably its most valuable application is the building up of worn areas on such parts as compressor rods, pump shafts, motor shafts, turbine shafts, valve stems and similar parts. Usually, parts of this nature are made of a hardenable material such as SAE 4140. Repairing such parts by welding is difficult, not only from the distortion standpoint, but also because the heat-affected zone becomes hard and may contain micro-cracks even if the build-up is done with an austenitic material like Type 310 stainless steel.

In metallizing, wire from a coil is driven into an oxyacetylene flame, where it is melted. The molten metal is dispersed by an air stream and blown against the surface to be built up. In metallizing a shaft, it is rotated in a lathe. The metallizing gun is mounted on the tool post of the lathe and moved longitudinally while the shaft rotates. Since the surface being sprayed remains relatively cool (about 400 to 600 deg F) the base metal does not harden or crack.

Surface preparation prior to metallizing is the most important single factor for successful shaft repair. First, the worn area is undercut.

It is well to keep in mind that the depth of undercut determines the thickness of the metallized surface. The thickness of the coating in turn determines the service life of the repaired part. On most shafts the undercut is about $\frac{3}{16}$ in. This undercut area may then be prepared by several methods. Cutting a rough-torn 30 deg thread, about 16 threads per inch, is one satisfactory method. Knurling the tops of the thread to a depth of about 0.015 in. further improves the bond.

The surface must be prepared without cutting oil and should be kept absolutely clean—not even touched—until the metallizing is done.

Type 420 stainless steel is excellent for work of this type. After spraying, the surface is finished either in a lathe or, preferably, by grinding.

Some hard surfacing materials may be applied by metallizing. Here the materials must be self-fluxing and are usually of the nickel-chromium-boron type. Variations in composition give hardness from Rockwell C32, which can

readily be finish-machined on a lathe, to C62 which must be finished by grinding. The hard surfacing materials are supplied in powder form and fed from a hopper into the metallizing gun. After spraying, the hard surfacing is fused by using an oxyacetylene heating torch.

The lathe must be kept operating while this surface fusion takes place or distortion will result. While the same type of surface preparation as for metallizing can be used, it is more common to roughen the undercut of the area by grit blasting. Steel grit is the best material to use for blasting, but aluminum oxide or a good grade of silica sand may be substituted.

What Size and Type of Electrode or Filler Metal Should Be Used for Mild Steel?

It is very confusing to select from the many types of coated mild steel electrodes available for electric arc welding. American Welding Society (AWS) identifies this group as E 60XX; E means arc welding electrode, and 60 represents 60,000 psi minimum tensile strength of as-deposited weld metal.

Table N. 2A—AWS Third Digit Code

Third digit	Positions of welding in which satisfactory welds can be produced
1	Flat, vertical, horizontal and overhead
2	Flat and horizontal fillets
3	Flat only

Table No. 2B—AWS Fourth Digit Code

Fourth digit	Power supply	Type of arc	Penetration	Quality
0	DC Rev. Pol. (a)	Digging	Deep (b)	High
1	AC or DC Rev. Pol.	Digging	Deep	High
2	AC or DC	Medium	Medium	Moderate
3	AC or DC	Soft	Light	Moderate
4	AC or DC	Soft	Light	Moderate
5	DC Rev. Pol.	Medium	Medium	High
6	AC or DC Rev. Pol.	Medium	Medium	High
7	AC or DC	Medium	Medium	High
8	AC or DC	Medium	Medium	High

(a) E6020 or E6030 can also use AC or DC—straight polarity.
(b) E6020, medium penetration; E6030, light penetration.

Third digit shown only as X designates the positions in which the electrode is suitable to weld. Fourth digit tells the power supply required, penetration, type of arc, and weld quality. Table 2A gives the interpretation of the third digit, while Table 2B gives the meaning of the fourth. Coated mild steel electrodes carrying AWS classifications are E6010-11-12-13-14-15-16-18-20-24-27-28 and 30.

E6010 electrodes are probably the most popular in maintenance work. They are for use with direct current and reverse polarity only. Thickness of the coating is held at a minimum to aid in welding in the vertical and overhead positions. Arc is forceful and deeply penetrating. This is a key feature in maintenance work where it is occasionally necessary to weld on somewhat dirty or rusty surfaces. E6010 electrodes, with their deep penetration, cleaning slag, and voluminous gas shield usually dig through and produce a satisfactory weld.

E6010 electrodes are excellent for pipe and structural welding. Although they are probably best suited for general maintenance work, many applications can be found where other mild steel types can be employed for improved properties, faster speeds or reduced welding costs.

E6011 electrodes are for use with alternating current, as well as direct current, reverse polarity. With alternating current they are comparable in performance to the E6010 electrodes; however, some sacrifice in usability characteristics will be observed when E6011 electrodes are used with direct current, reverse polarity. E6011 electrodes are particularly useful for weldments which include corner welds and similar locations where arc blow is encountered with dc welding.

E6012 electrodes are intended for general purpose welding where deep penetration is not desirable. They burn with a quiet, stable arc, produce little spatter, and completely cover the weld with a dense but easily removable slag deposit. E6012 electrode is often referred to as a "poor fit-up electrode" due to its ability to bridge gaps in irregularly fit-up joints such as is found in structural and machine weldments.

The light penetration quality sometimes allows the successful welding of low alloy steels, since the weld bead does not dilute with enough alloy or carbon steel from the base metal to crack. While the E6012's are all position electrodes they are used primarily in the flat and horizontal positions. If in vertical or overhead welding, the electrode used is frequently one size smaller than if an E6010 or E6011 electrode were used. E6012 electrodes operate best with direct current straight polarity, but can be used with alternating current.

E6024 electrodes are iron powder modifications of the E6012 electrodes. Their deposition rate for comparable sizes is approximately twice as great, and their ease of handling and excellent appearance bring good operator acceptance.

E6013 electrodes are available in two modifications. One variety is an excellent all-position sheet metal electrode. Second variety is used on heavier applications such as field erected storage tanks. These electrodes are easy to use, have little tendency to undercut, practically no spatter and excellent weld appearance. As in the case of E6012 electrodes, the penetration is light and the arc is soft.

E6014 electrodes are iron powder modifications of the E6013 electrodes. They have a higher deposition rate, even easier slag removal, and excellent weld appearance.

E6015 and E6016 electrodes are known as low hydrogen electrodes. E6015 is a direct current, reverse polarity electrode while the E6016 is its alternating current counterpart. Experience has shown that the performance of the E6016 electrode on direct current reverse polarity is entirely satisfactory and consequently E6015 electrodes are dropping out. Low hydrogen electrodes became available after World War II. Keeping free hydrogen in the arc zone low had proved to be a successful solution to the under-bead cracking problem in welding armor plate.

These electrodes have found extensive application in maintenance. They are used for repair work where cracking might be a problem and where excellent physical properties are desired. High sulphur steels are best welded with low hydrogen electrodes. Free machining steels usually contain sulphur, which, causes porous welds when other electrodes are used.

Care must be taken with low hydrogen electrodes or they will pick up atmospheric moisture. Suppliers usually pack them in moisture-proof containers, but once the container is opened the electrodes can pick up sufficient moisture in several hours to cause detrimental results.

There are two solutions to the problem. One is to buy the electrode in small containers so that once opened it is quickly used. The other is to keep the container in a heated

oven after it is opened. If the electrode does pick up moisture it can be dried out by baking at 600 to 700 deg F for several hours.

E6018 electrodes are iron powder varieties of the E6016 electrodes which give higher deposition rates with the same high quality.

E6020 and E6030 electrodes are commonly referred to, by welders, as "hot rods." E6020 electrodes are used for horizontal fillet welds and for flat position groove and fillet welds. E6030 electrodes have a somewhat higher deposition rate than the E6020 electrodes and are used only for flat position work, primarily groove welding and in tank and pressure vessel welding but they are giving way to a large extent to automatic welding processes and to iron powder electrodes.

E6027 electrode is an iron powder modification of the E6020 electrode while the E6028 is an iron powder low hydrogen electrode primarily for downhand welding. Both of these electrodes offer very high deposition rates especially for flat position fillet welds.

Table No. 3—AWS-ASTM Code With Acetylene

Welding rod classification number	Plate thickness (in.)	Treatment of welds (a)	Tensile strength psi	Minimum elongation in 2 in., in. %
GA 65	3/4	SR	65000	20
		NSR	72000	17
GA 60	3/4	SR	60000	25
		NSR	62000	20
GA 50	3/4	SR	50000	28
		NSR	52000	23
GB 65	3/4	SR	65000	18
		NSR	72000	15
GB 60	3/4	SR	60000	20
		NSR	62000	15
GB 45	3/8	NSR	45000	—

(a) SR designates stress relieved
NSR designates not stress relieved.

Welding rods available for acetylene welding of mild steel are listed in Table 3. The letter G designates it as a gas welding rod. The two numbers shown give the tensile strength in 1,000 psi. A second letter A or B refers to the degree of elongation. Grade A has a slightly higher elongation than B.

What to Use for Low Alloy Steels

American Welding Society electrode designation system, previously explained while discussing mild steels, also applies to the low alloy materials. However, since the tensile strength of some of these materials is higher than 100,000 psi, it may require the first three digits to designate it. For example an E12016 would be a low hydrogen type electrode with a 120,000-psi tensile strength.

Table No. 4—Suffixes For Low Alloy Steels

Suffix	Carbon (%)	Molybdenum (%)	Chrome (%)	Nickel (%)
A1	0.10	0.45 to 0.65	—	—
B1	0.10	0.40 to 0.65	0.40 to 0.65	—
B2	0.10	0.40 to 0.65	1.00 to 1.50	—
B3	0.12	0.90 to 1.20	2.00 to 2.50	—
C1	0.12	—	—	2.00 to 2.75
C2	0.10	—	—	3.00 to 3.75

Table No. 5—Low Alloy Working Temperatures

AWS classification number	Preheat and interpass temperatures (deg F)	Stress relief temperatures (deg F)
E 70XX	200 to 225	1150 ± 25
E XX15	" "	" "
E XX16		
E XX10	325 to 375	" "
E XX11	" "	" "
E XX13	" "	" "
E XXXX-B3	" "	1350 ± 25

In low alloy type electrodes we are usually interested in knowing the chemical composition so that we can match the base metal chemistry. Table No. 4 shows the designations to cover chemical analysis of electrodes. While a complete classification number for mechanical properties alone would be E7010, a classification to cover chemical analysis also would be E7010-A1.

Low hydrogen type electrodes are very effective in welding materials of this type where under-bead cracking could be a major source of trouble. Pre-heat interpass and stress relieving temperatures are listed in Table No. 5.

Table No. 6—Stainless Steel Filler Metals

AWS-ASTM classification No.	Carbon (%)	Chromium (%)	Nickel (%)	Molybdenum (%)	Columbium plus Tantalum (%)
E 308, ER 308	0.08 max.	19	9	—	—
E 308 ELC, ER 308 L	0.04 max.	19	9	—	—
E 309, ER 309	0.15 max.	25	12	—	—
E 309 Cb	0.12	25	12	—	0.7–1.0
E 309 Mo	0.12	25	12	2–3	—
E 310, ER 310	0.20 max.	25	20	—	—
E 310 Cb	0.12	25	20	—	0.7–1.0
E 310 Mo	0.12	25	20	2–3	—
E 312	0.15	29	9	—	—
E 316, ER 316	0.08 max.	18	12	2–2.5	—
E 316 ELC, ER 316 L	0.04 max.	18	12	2–2.5	—
E 317, ER 317	0.08	18	12	3–4	—
E 318	0.08	18	12	2–2.5	6 x C min. to 1.00 max.
E 330, ER 330	0.25 max.	15	35	—	—
E 347, ER 347	0.08	20*	10	—	8 x C min. to 1.00 max.
E 410, ER 410	0.12 max.	12	—	—	—
ER 420	0.25–0.40	12	—	—	—
E 430, ER 430	0.10 max.	16	—	—	—
E 502	0.10 max.	5	—	0.45–0.65	—

Chromium shall be 1.9 x Ni, min., when so specified.

What to Use for Stainless Steels

Table No. 6 lists the many different types of stainless steel filler metals and their composition. A quick glance at this list shows how inadequate it would be merely to describe the metal a part is made of as "stainless steel." This tabulation not only includes the coated electrodes for arc welding, but also includes the bare wires for acetylene, submerged arc, or inert gas welding.

The prefix E refers to metal arc electrodes, while the prefix ER designates a bare wire that could be used as an electrode for either the submerged arc or metal inert gas process or as a rod for acetylene or tungsten inert gas welding. Number following E or ER is the AISI stainless steel type number.

Suffixes ELC and L both signify extra low carbon content. Two other suffixes, Mo and Cb, represent the addition of molybdenum and columbium, respectively. Coated electrodes use much the same designation system as for mild steel electrodes except that the AISI number is substituted for the digits representing tensile strength.

For example, in an E310-15 electrode the E means it's an electrode, the 310 says it is an AISI Type 310 stainless steel, and the 1 and 5 have the same meaning as explained in Fig. 2A and 2B for mild steel.

Type 308 filler metals are used to weld the 18-8 grades

of stainless steel (AISI Types 301-302-302B-304-305 and 308). There is little difficulty in welding these materials. Type 303 is the free machining grade of 18-8 and it gives more welding trouble since the addition of sulphur or selenium tends to evolve gas.

Carbide precipitation at the grain foundries tends to occur when many stainless steels of the 300 series are exposed to temperatures in the range of 900 to 1500 deg F during fabrication or service. This results in impaired corrosion resistance. Carbide precipitation is resisted by keeping the carbon content low or by adding columbium, which combines with the carbon. Proper annealing can restore the original corrosion resistance if it is practical to do so.

Type E309 and E310 electrodes join metal of their own composition without difficulty. However, they are both widely used to join dissimilar materials. An example would be joining Type 308 stainless to mild steel. These electrodes have both been very successful in welding hardenable steels without cracking. However, there can be little doubt that the heat affected zone is extremely hard when this is done. Type E309 and E310 have been used to attach type 405 and type 410 strip liners to refinery vessels without preheat or stress relief.

Type 410 and 420 stainless steels present a problem because of their air hardening tendencies. Both preheating and stress relieving are essential to achieve sound welds and serviceable ductility.

The 5-chrome, ½-moly filler metal (E502) finds wide use in refinery piping systems. It is also air hardening and requires preheating and stress relieving.

Light gage materials under $\frac{1}{16}$ in. thick are best welded with the tungsten inert gas process. Metal inert gas, however, is much faster than tungsten inert gas welding for thicknesses over ⅛ in. Submerged arc welding gives excellent results on stainless and is probably the most economical process where applicable.

Does the Object Have a Hard And Corrosion Resistant Surfacing?

When worn, corroded or eroded parts come in for repair, it is often possible to build them up with a material more resistant to future damage. In the discussion of metallizing, a sprayed and fused hard surfacing repair of a shaft was mentioned.

Numerous hardfacing materials are available for application by acetylene, manual electric submerged arc, inert gas, and open arc welding. Care must be taken to select the proper one. Material best suited for high temperature abrasion resistance in a catalytic cracking unit would be different than one selected to prevent wear on the teeth of a crane bucket operating at atmospheric temperature.

If an alloy can be applied either by gas or electric welding, the gas process will give the highest quality. This is because the arc process dilutes the deposit with molten base metal while in acetylene welding a good operator can hard-surface with practically no dilution.

Often the application of stainless steel or bronze to a part greatly extends its service. Mild steel ring type joint flanges often corrode on the surface between the inside diameter and the ring groove. Cladding these surfaces with Type 309 or Type 310 stainless effectively extends their life.

How to Handle Cast Iron

Cast iron presents many difficult maintenance welding problems. It can be repaired, using the acetylene welding process, either by welding or by brazing. The electric arc process, using either a copper or a nickel base welding electrode, can also do a satisfactory repair job.

To acetylene weld cast iron, the entire casting must be preheated to a temperature of around 800 to 1100 deg F. Temperatures as high as 1400 deg F might be required on larger castings. Usual practice with large castings is to build a fire brick furnace around them, and preheat with gas burners or with a charcoal fire. A filler metal designated as R-CI, which is a bare wire cast iron rod, is used.

The area to be welded is preheated to a dull red color, and the filler rod is heated and dipped in a powdered flux. Base metal and the filler wire are then "puddled" together in the proper proportions adding flux as necessary. Arc welding could also be done with an E-CI coated cast iron electrode and with the casting preheated in the same manner.

After welding the casting must cool slowly, or cracking will result. In the case of large castings, the parts should be left in the furnace and the heat source gradually cut off. Smaller parts can be covered with powder or covered with lime and sand. Weld deposits made in this manner are readily machinable.

Table No. 7—Rod and Electrode For Cast Iron

AWS-ASTM classification	Copper (%)	Zinc (%)	Tin (%)	Iron (%)	Aluminum (%)	Nickel (%)	Manganese (%)	Phosphorus (%)	Silica (%)
R Cu Zn-A	57.0	43.37	—	—	—	—	—	—	—
R Cu Zn-B	56.0	41.87	0.75	0.63	—	0.50	0.25	—	—
R Cu Zn-C	56.0	41.09	0.94	0.75	—	1.00	0.25	—	0.15
R Cu Zn-D	45.0	44.60	—	—	—	10.0	—	0.25	0.15
R Cu A1-A2	88.4	—	—	1.5	10.0	—	—	—	0.10
E Cu So-A	94.45	—	5.3	—	—	—	—	0.25	—
E Cu Sn-C	91.65	—	8.0	—	—	—	—	0.35	—
E Cu A1-A2	88.4	—	—	1.5	10.0	—	—	—	0.10

Table No. 7 shows the analysis of copper base filler metals used for cast iron repair. Brazing with these copper base materials is a very effective method of cast iron repair. The materials are soft and ductile at high temperatures and give readily as the cast iron cools. As the filler metal temperature falls the last few hundred degrees it reaches its proper strength level.

Table No. 8—Nickel-Base Electrodes

AWS-ASTM classification	Nickel (%)	Copper (%)	Iron (%)	Silicon (%)	Manganese (%)	Carbon (%)
E Ni	98.0	0.50	0.50	0.75	0.50	0.15
E Ni Fe	56.0	0.50	41.75	0.50	1.00	0.25
E Ni Cu-A	58.0	36.20	2.50	0.75	2.25	0.30
E Ni Cu-B	68.0	26.20	2.50	0.75	2.25	0.30

Table No. 8 lists four nickel base welding electrodes available for cast iron welding. Preheating and slow cooling are common procedures when using these electrodes. However, successful welds can be made cold, if the casting is clean and free of "soaked-in" oil. Care must be taken in cold welding not to build up excessive temperatures, or cracking from thermal expansion will result.

What to Do With Aluminum

Inert gas processes have revolutionized aluminum welding. Considerable precaution must be given to oxide coatings in inert gas aluminum welding. Just prior to welding it is a good practice to clean the surface with a file. If a grinding wheel is used, difficulty with the aluminum picking up wheel grit can result. The A1-2 pure aluminum and the AL-43, 5% silicon filler wires give good performance.

When and How to Grind Drill Bits

THE SUREST WAY to get the most out of drill bits is to resharpen them before they reach the point of uneconomical service.

According to the Bay State Abrasive Products Co., stopping the rig and changing the bit at the right time will ensure better operation on two counts. First of all, it will give maximum drilling speed, saving power and time, and secondly, the longest useful life will be gotten from the bit because it will be reconditioned before damaging itself in the hole.

The main problem, then, is knowing when to grind. In deep drilling, where pull-out is time-consuming, keeping up-to-the-minute drilling rate records can be invaluable. The initial steady penetration rate gradually tapers off as bit loses its cutting shape. Continuing this fall-off (at a more or less regular rate depending on both the rock and the drill), the drilling speed approaches the final, rapid fall-off which means complete dullness.

On short hole work, the bit's appearance can more easily be checked. The operator should periodically compare the cutting edges on the bit in use with the ones on a new or recently ground bit.

The second point to consider in good bit maintenance is how to grind. Bay State's "Rock Drill Bit Grinding Wheels" gave the following basic rules: (1) Always grind any bit to the same shape it originally had; (2) remove only enough of the supporting stock behind the cutting edge to get the required clearance; (3) grind uniformly along the full length of each cutting edge; (4) grind wet whenever possible. When dry grinding is necessary, protect operator against dust; (5) keep grinding wheels properly dressed; and (6) do not exceed maximum speeds marked on wheels.

Proper sharpening of the various types of drill bits calls for correspondingly varied grinding procedures.

Percussion type rock bits may be ground by either machine or hand-held methods. The first operation is safer and more accurate. Machines specifically designed for rock grinding have constant, controlled speeds. The firmly clamped bit is always in the correct position, thereby producing uniform angles. When machine operations are no longer practical, hand-held grinding may be put to use. If bit is placed on a bench or pedestal, it should be fixed in a short section of drill rod to help control the angles and grinding pressure. Portable units are used for on-the-job grinding of larger bits. Since the wheel must again be positioned by hand, the bit must be clamped in a conveniently accessible position.

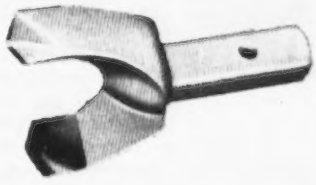
Bay State's basic rules for grinding the carbide inserted type of drill and mining machine bits include: (1) Grind supporting steel first, using an aluminum oxide wheel; (2) grind as little carbide as possible to restore the shape, using a silicon carbide wheel; and (3) grind either completely wet or completely dry because the carbide tends to crack when subjected to temperature changes. If dry grinding is necessary, set the bit aside to cool as soon as it becomes too hot to touch.

Every grinding wheel is a complex, multi-edged cutting tool made up of sharp abrasive particles. Bay State says that "if the cutting units are the right type and size, if they are correctly spaced, and if they are held together with just the right strength, the outer layer of particles touching the drill bit will grind until almost dull, then break to form new cutting edges, or drop off and let other particles do the cutting."

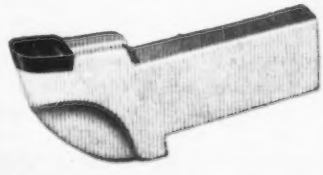
Here, according to the company, are some grinding procedures for rotary and mining machine bits.

Different Bits Require Different Methods

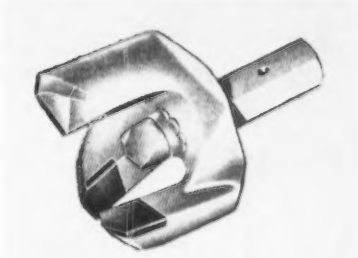
Roof Drill Bits—Grind uniformly along the entire length of each cutting edge (not just the parts which are dull). Keep the angle between the cutting edges the same as on a new bit. Too sharp an angle will cause wedging in the hole.



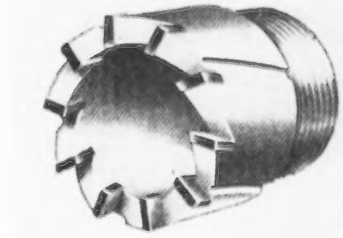
Auger Drill Bits—Where necessary, grind both prongs to the same length. Then recondition all cutting edges of each insert separately.



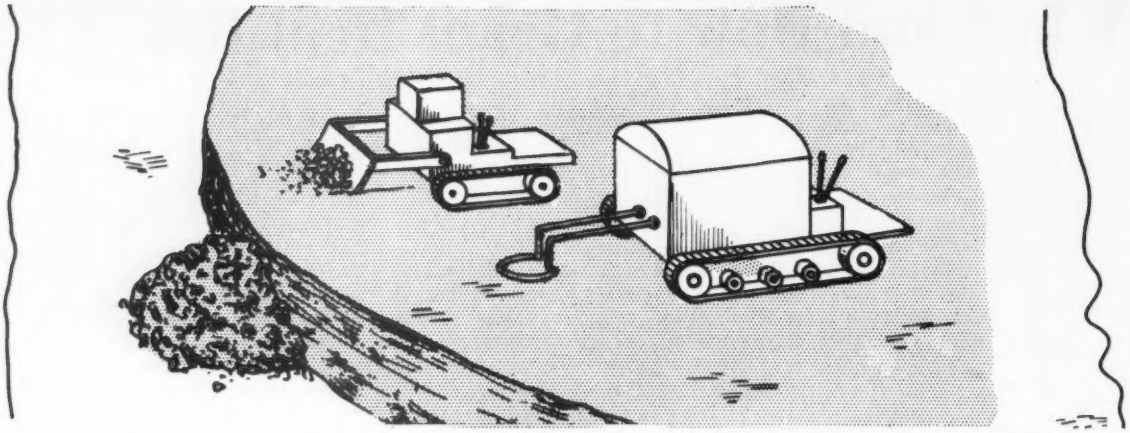
Mining Machine Bits—Grind the steel to minimum clearance, on both right and left hand sides of the bit, making sure the entire cutting edge of the insert has clearance. With a slightly grooved wheel-face, grind the whole cutting edge to the same curvature as a new bit.



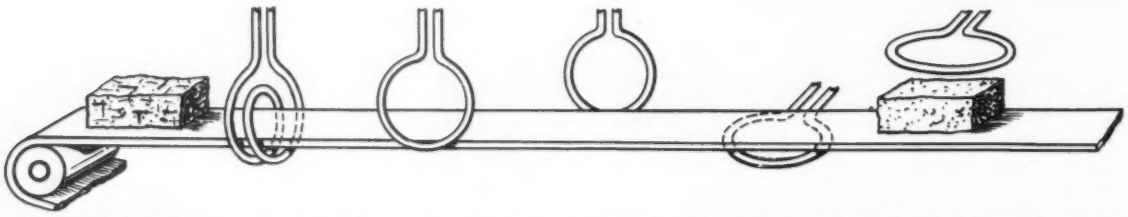
Earth and Rock Boring Bits—Grind cutting edges on both sides of the point, for each insert in turn, using a back and forth motion. Reproduce all original angles.



Core Bits—These can be ground most accurately on a tool-grinding machine. When grinding free-hand, extra care should be taken to keep tooth height even, so that all teeth will cut.



FOR MINING, a tractor is equipped with a high frequency generating unit and a pancake-type transmitter coil mounted close to the ground. With overburden removed, the tractor traverses the taconite bed, subjecting it to high frequency energy. Fractured material is removed, exposing a new layer; dozing it off the edge of a bench further breaks-up any blocks.



FOR PROCESSING, coils are mounted around an asbestos conveyor belt in several possible arrangements. The combination of coils on opposite sides of the belt could subject the rock to a series of surges of energy of different frequencies, which may be desirable for some purposes. A short fall from the end of the belt will easily cause any chunks to crumble.

Induction Breaking Is Patented As Tool for Taconite Industry

THE REVOLUTIONARY POTENTIAL of breaking rock without the contact of mechanical elements has reached a new peak of promise with the patenting of high frequency electromagnetic induction as a method of fracturing taconite. The US patent (No. 2,859,952) covering the method was granted on November 11, 1958, to Harry LaTour and Howard Day Wren, assignors to Armco Steel Corp., Middletown, Ohio.

"Energy on the order of 25 kilowatts at a frequency of about 4 to 7 megacycles per second will successfully fracture taconite," the authors state. The energy can be applied by passing material through a coil or by passing a "pancake coil" close by. Operable regardless of weather, the method can thus be used to break taconite in place or in processing. It can also be used to beneficiate by selective fracturing.

Fracturing apparently results from tensile failure due to localized differential expansion produced by one or more of the thermal, piezo-electric and magnetostrictive effects of the alternating electric field on the magnetite-bearing quartzite rock.

Specific Example

In a simple example, the authors say a 15x15x15-in. lump of Upper Cherty taconite was placed within a 16-in. square loop of ⅜-in. dia copper tubing which was internally water cooled. The loop was connected to a 25-kw 5-megacycle generating unit which "was adjusted for 2.7 to 2.9 plate amperes and 200 to 250 grid milliamperes. As soon as the high frequency energy was applied the rock began cracking immediately. Further time under load enlarged the cracks and spalling began to take place."

"The cracks appeared not only parallel to the strata but also perpendicular to it and the broken portions had a generally cubic form. Brightly heated regions appeared from the beginning of the application of power and increased in area and temperature with time. After considerable time under load under the coupling conditions used, an eruption of molten material took place . . . this high frequency treatment resulted in a loss in strength . . . and the treated ore could be crumbled with light blows of a hammer."

Tensile failure is emphasized by the authors since the tensile strength of taconite is only 1/30 the compressive strength and thus "the energy requirement for tension fracture might be as low as 0.14% of the energy required for compression fracture." They also point out that the temperature difference needed to produce tensile fracture in quartz conglomerate is only about 25 deg F.

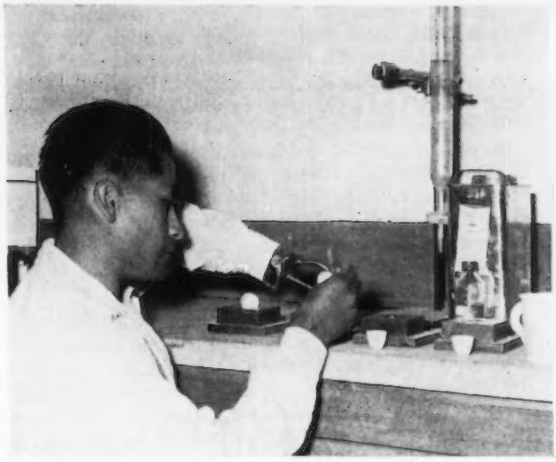


PLATE NO. 1—First step in examining a milling problem with the microscope, camera and color film is to prepare a briquette using thermosetting Laminac® 4110 polyester resin with methyl ethyl ketone peroxide as a catalyst.

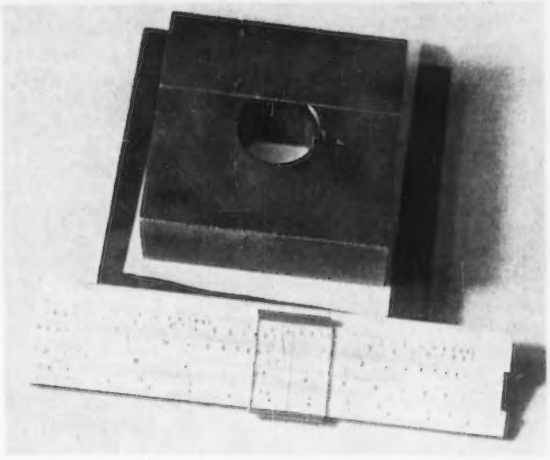


PLATE NO. 2—The briquetting mold is a 4-in. square steel plate with a 1-in. hole drilled in the center and ground to a mirror polish, then covered with a thin film of Silicone No. 8, and rubbed dry. Dried sample and plastic are added.

Color Microscopy for the Mill Man

E. P. CADWELL

ONLY THROUGH ADEQUATE USE of the microscope can a mineral deposit be exploited to the fullest extent without wasting both time and money in cut-and-try test work. Microscopy is not new to mineral dressing. As a matter of fact, during my course in mineral dressing more than 25 years ago I spent most of my time briquetting, polishing and counting particles.

Yet, today, I find few mills with adequate microscopic equipment—even metallurgical laboratories and schools almost completely ignore one of the most important tools of the mineral dressing profession.

> *"Many persons hold the opinion that the metal industries are fortuitous and that the occupation is one of sordid toil, and altogether a kind of business requiring not so much skill as labor. But as for myself, when I reflect carefully upon its special points one by one, it appears to be far otherwise. For a miner must have the greatest skill in his work, that he may know first of all what mountain or hill, what valley or plain, can be prospected most profitably, or what he should leave alone; moreover, he must understand the veins, stringers and seams in the rocks. Then he must be thoroughly familiar with the many and varied species of earths, juices, gems, stones, marbles, rocks, metals and compounds."*

Undoubtedly many readers will recognize the above paragraph as the introduction to *De Re Metallica*, written by Georgius Agricola in 1555, which was a logical guide to the mineral industry of that day when deposits being worked were simple, close to the surface, and certainly much richer. It seems definitely more important today when many of our mineral deposits are complex, deep-seated, and certainly much leaner than those exploited prior to the publication of Agricola's masterpiece.

Yet many mineral deposits are being explored and exploited today, solely upon evaluation based upon chemical analysis, often resulting in uneconomic operations and with grave doubts always in the mind of the operator.

PLATE NO. 3—Polishing procedure used by E. P. Cadwell was devised by Dr. Edward Sampson, Princeton University. Polishing is done on a hard weave nylon cloth over a steel lap wheel (10-in. dia). Polishing takes less than five minutes.

Naturally, few mills are built without first having run the ore through a long series of laboratory batch tests either on flotation, cyanidation or leaching. To be sure, the results of these tests can be assumed to be typical of a plant-scale operation with or without pilot plant work, but the batch work is generally conducted on a trial-and-error basis.

With the aid of the microscope and with properly prepared specimens, much can be learned about the minerals in any ore—their combinations, the degree of locking, dissemination, oxidation, tarnish and coatings.

Such fundamental knowledge as mentioned above is

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often attained as a last resort rather than as a preliminary to laboratory testing. It is now the author's project to examine mill products of operating plants and attempt to classify the deposits from which they come, not so much as to the metallic values but as to the correlation of the metallic value with the physical condition of the minerals, and afterwards to compare the existing metallurgical treatment with operations having similar mineral combinations.

As one visits plants where similar ores are being treated, one is amazed to note the difference in the methods of treatment. The question is: are the differences in flowsheet and reagent combinations due to the idiosyncrasies of the individual operator, or is the physical combination of the minerals in the ore so different that such radically divergent treatment is necessary?

One mill operator will replace another and completely change reagents, pH, grind, and also flowsheets. In many cases he continues until he ends up with metallurgical results about the same as his predecessor's. In some cases, however, improvements are noted. The fact that improvements are noted is natural and these will be made even under the customary cut-and-try methods, with a limit of 100% recovery at zero treatment cost per ton.

How much better it would be, however, to know the metallurgical limits beforehand and be able to guide the changes and predict the results. It is the author's contention that the classification of mineral combinations from widely separated areas may eventually lead to more economical mineral exploitation and will bring knowledge gained from a great many operations (even though treatment methods were devised by cut-and-try techniques) within the reach of the individual mineral dressing engineer. A brief summary of how microscopic analysis aids the various branches of the mineral dressing profession follows:

Cyanidation requires much vigilance in knowing the mineralogical occurrence of precious metals, points of liberation and presence of cyanicides. Microscopic analysis can often save many tests by identification of the valuable mineral or metal, indicating the mesh of grind required for liberation and the necessity of flotation for preconcentration, or roasting the whole ore or the concentrate for liberation prior to cyanidation (see Plate No. 26).

A preliminary examination of an oxidized ore may determine whether it can be leached economically, by revealing the percentage of soluble minerals, their liberation from gangue, the presence of worthless lixiviant-consuming minerals, or the presence of detrimental minerals. With such a background, the various well-known chemical processes can be brought into play.

In one instance in which the microscope aided a small leaching operation where the recovery did not exceed 75%, it was revealed that 35% of the copper in the heads existed as a sulphide and even though the plant extracted about one-third of the sulphide copper, fine grinding and flotation were indicated if extractions in the 90% to 100% range were to be attained.

Inasmuch as most of the problems brought to the attention of the writer have been in the field of flotation, much of the following discussion will be in that field. The reason for this, of course, is the nature of the minerals found in the particular areas in which the author has spent the past 15 years; however, some ores amenable to both cyanidation and leaching have been brought to the laboratory and have been examined, and opinions rendered.

Flotation test work without adequate knowledge of the mineral components and their condition as found by microscopic analysis becomes a process of elimination. During testing it is necessary to try all activators, choosing some while discarding others, to investigate the wide range of promoters and combinations of promoters, as well as to determine whether one grinds finer or coarser as dictated by the results of chemical analysis.

Volumes have been written on choices of collectors for specific minerals and mineral combinations. Methods for dispersing or depressing the undesirable minerals have come in for their share of investigation and subsequent reporting.

The means for extraction at optimum return have been the subject of voluminous technical publications. But without the exact knowledge of the component minerals of an ore (both valuable and gangue), their physical status, and their degree of locking with each other, the mineral dressing engineer is not in a position to benefit from the published material on work being carried on so diligently.

In our laboratory we have found that the microscope, with techniques described later, aids a great deal in pointing out the ultimate limits of concentration and leads the way to more efficient test work prior to plant-scale operation. The actual procedures are described below.

Color Photographs Vividly Spotlight the Problem

REPRESENTATIVE samples of mill products, preferably air dried or in pulp form, are received at the laboratory and wet-screened on all meshes from the coarsest through 325 mesh, after which the products are dried on their respective screens under infra-red light or by air; at least, not by any heat that will in any way alter the products.

Samples should never be subjected to heats that would tend to roast the products. The dried sample should be re-screened to remove adhering slimes. If necessary, the material passing 325 mesh can be further sized by an infrasizer or by elutriation with a stream of water.

It generally will be found that in the sub-sieve sizes the material will tend to flocculate and separation is difficult. A dispersant is recommended. Inasmuch as we have little or no control over the flotation of such small particles, we do not spend too much time on their examination.

The dried sample is well mixed and a two-gram portion is weighed out and placed in a 15 cc porcelain crucible, in preparation for briquetting (see Plate No. 1).

The mold, a 4-in. square steel plate with a 1-in. hole drilled in the center and ground to a mirror finish, (Plate No. 2) is then covered with a thin film of Silicone No. 8[1] and rubbed dry. It is then placed on a plate glass that has been covered with a piece of smooth bond paper.

The thermosetting resin used in making briquettes is American Cyanamid Co.'s polyester resin, Laminac® 4110, with Lupersol DDM[2] (methyl ethyl ketone peroxide) as a catalyst. Both are in liquid state at room temperature. The catalyst is used in quantities of from 1 to 3%, depending on the speed of hardening desired. The more catalyst, the shorter the hardening time.

For mill products, a 1 to 5% paste of carbon black (black pigment paste PMS-4640[2]) is added to the Laminac polyester resin to prevent internal reflections. This material neither accelerates nor inhibits hardening.

Sufficient freshly-polymerized plastic is poured into the crucible over the weighed sample to completely wet all the particles. After stirring, the resultant mixture is then poured

into the mold. The mixture will spread readily over the bottom of the mold. Additional plastic is then poured in to fill the mold. The reason for not mixing the entire quantity of plastic with the sample is that settling through that distance could produce stratification, segregation, and erroneous results. There is adequate time before hardening to pour 20 to 30 briquettes.

At the completion of the pouring it is well to let the briquette stay in the mold for about 15 minutes, or until a pencil point will depress the upper surface but will not penetrate it. The mold is then turned on its side and the paper peeled off. When the briquette is hard, or after about 25 minutes, it can generally be released by merely pushing with the thumb. In the event that some of the liquid plastic is inadvertently poured over the top of the mold, the tenacity is such that it may require a slight tap by some metallic object to break the bond.

An identifying number on a tag board may be floated on the surface of the briquette immediately after pouring. The viscosity and surface tension are so great that the identifying number will not sink but will be solidified in place with a slight coating of plastic over its surface, thus identifying the briquette for the future.

After removal of the briquette from the mold, it is well to put a bevel on both ends with a file, to protect both the nylon polishing cloth and the fingers. The briquette is then subjected to a grinding with American Optical No. 302½ abrasive[3] on a cast iron lap wheel to remove plastic from the surface of the particles and put all exposed particles into a plane.

After the plane surface has been established and the particles are exposed, the briquette is ready for polishing. Preliminary grinding is quite necessary because to polish off the exposed plastic would unnecessarily load the nylon cloth with plastic, thus cutting down the polishing efficiency. The grinding step generally involves no more than a minute, depending on the smoothness of the bond paper used when casting the briquette.

The polishing step which we use is one devised by Dr. Edward Sampson, Princeton University, and described in *Economic Geology*, August 1956.[4] Polishing is done on a hard, fine-weave nylon cloth[5] over a steel lap wheel of any desired diameter. We use a 10-in. dia wheel. For the first step in polishing, 6-micron diamond paste[6] is applied to the nylon surface in minute quantities (approximately ¼-in. ribbon of paste is extruded) and rubbed into the cloth at various points along a radius.

We have found that if a briquette of about 50% by volume of high-grade galena concentrate is applied to the lap wheel in motion, along with generous amounts of kerosene, the cloth will turn black and all the voids in the nylon cloth will be filled, resulting in a splendidly lubricated lap, and a better and quicker polish than is attained by the kerosene alone. A lap thus prepared will polish at least 25 briquettes and in some cases well over 100.

One of the pitfalls of any polishing method is loosened particles that ride the wheel and score the entire briquette. This may be caused by lack of tenacity of the plastic for the particles owing to acid films on sulphides or by overheating of the briquette owing to lack of proper lubrication.

With the galena-treated lap this is at a minimum. Excessive speeds at the beginning of the polishing cycle have a marked effect on overheating and should be avoided. We generally start the polish at a speed of 500 rpm and gradually increase to 800 rpm at the finish.

The time necessary for polishing depends on the material being polished. If the briquette contains all the same mineral, let us say sulphide with very little silicate, one minute usually suffices for an acceptable polish. Tailings, classifier overflows, or head samples with high silicate content may require as long as five minutes to get an acceptable polish.

The first lap wheel with 6-micron diamond paste is usually sufficient for routine work. However, for more exacting work and for photomicrography, polishing with one-micron and ¼-micron diamond paste on separate lap wheels is recommended. Frequent inspections on the microscope during polishing often aid in the work.

During polishing the briquette is held firmly between the thumb and forefinger (Plate No. 3). Start the polishing near the center of the lap and work to the outside. Every 15 seconds the briquette is rotated 90 deg and moved an inch or so toward the periphery of the wheel. A lubricant (kerosene) is best added sparingly to the wheel in the form of a spray from a common throat or nasal atomizer.

Washing the briquette well in ethyl alcohol to remove any adhering grit or grease is recommended between laps and before microscopic inspection.

A cover should be placed over the lap wheel when not in use to protect the cloth from atmospheric dust. Such foreign bodies may be detrimental in two ways; if large they may tear the nylon cloth, and if larger than the polishing abrasive, they may scratch the briquette.

Quite naturally it is impossible to prevent dust, grit, and other foreign bodies from falling on the lap wheel during operation, but this may be minimized by installing a glass hood over the polishing apparatus, thus preventing contamination due to dust and dirt falling from the ceiling. An evacuating fan can also be very helpful in preventing foreign bodies from falling on the polishing wheel.

Upon completion of the polish on the lap wheel, a brisk rub with Gamal levigated alumina on Gamal cloth[7] polishes the plastic, thus giving a slight amount of relief to the particles. The briquette is now ready for microscopic examination and counting.

On the following pages are shown a number of color photographs of briquettes prepared in the manner described above (Plate No. 4 to 26). Also included are brief descriptions of the minerals illustrated in the photographs and the problems they involved.

During the examination of the mill products from almost 50 mills operating in South America, some interesting mineral combinations have been encountered.

Colored slides have often been taken by the author to illustrate certain approaches to the existing mineral dressing problem. For many individuals who have not been trained in the use of the microscope, it has been found more practical to take colored pictures of a series of particles representing the problem and then in their presence to project them and discuss the problem.

After seeing the greatly enlarged particles representing the problem, it is much more feasible for the average engineer to look through the microscope and comprehend the scanning of many thousands of similar particles.

The following slides were taken with that idea in mind, and in each case the pictures were projected and explained before the client was introduced to the microscope to view the products representing his individual problem.

These slides were taken with an Exacta Camera, Model XV, using Ektachrome 35mm artificial light film. The exposure of ½ second was found by experiment to be the best and to produce the truest rendition of color. A Kodak C82 filter was used. The camera lens is removed and a

[1]Silicone No. 8 is a product of Onyx Oil & Chemical Co., Inc., 190 Warren St., Jersey City, N. J., and can be purchased through plastic supply houses.
[2]Available through plastic supply houses such as Plastic Molders Supply Co., Inc., 74 South Ave., Fanwood, N. J.
[3]American Optical Co., 20 West 47th St., N. Y. 36, N. Y.
[4]"A Procedure for Polishing Ore Sections with Diamond Abrasive," by Edward Sampson, *Economic Geology*, August 1956, pp 482 to 484.
[5]Tetcosilk 12XX taffeta weave, 123 mesh, from Abbe Engineering Co., 50 Church St., New York 7, N. Y.
[6]Sized diamond paste comes in tubes of five grams each. They fit into an applicator in the form of a syringe and provide an easy, economical method of application. Supplied by A. Buehler Ltd., 2120 Greenwood Ave., Evanston, Ill.
[7]Gamal polishing cloth for metallography, No. 12-282; Gamal polishing alumina No. 12-291; from Fisher Scientific Co., 635 Greenwich St., New York 14, N. Y.

tube which fastens over the monocular of the microscope is fitted to the camera. The ocular of the microscope becomes the lens of the camera. In some cases the same mineral does not appear exactly the same color in two plates. This is neither the fault of the film, the photographer, nor the developing, but is due to the absorptive and reflective influence of other minerals in close proximity.

PLATES NO. 4, 5, AND 6
Origin: Mine A, Peru
Particle size: minus 200- to plus 325-mesh
Magnification: Plate No. 4, 80 diameters; Plate No. 5,325 diameters; and Plate No. 6, 800 diameters
Identification: copper concentrate sample—pyrite (yellowish white), covellite (deep blue), chalcocite (bluish gray), chalcopyrite (golden yellow) and siliceous gangue (dull gray)

The concentrate was presented to the author with the request to find the reason for such low concentrate grade (30.8% Cu), when the copper minerals had been identified as predominantly chalcocite with minor amounts of covellite and chalcopyrite. Hand lens examination of the concentrate produced in pilot plant operation showed a completely dark product indicating an almost pure chalcocite or covellite concentrate. Little or no pyrite or chalcopyrite was visible.

The sample was prepared in the usual manner and microscopic examinations made of the sized fractions. At the lower magnification, I was amazed to find such a preponderance of pyrite and was somewhat at a loss to explain its presence under the microscope and complete absence under the hand lens.

At the next higher magnification an explanation was still lacking, but at 325 diameters a faint blue rim of covellite began to appear. At 800 diameters the coating was significant and explained the action of these particles in a flotation circuit as well as the black appearance of the material in unpolished section. The minute coating varied from a fraction of a micron to 20 microns thickness in some cases; but, in any event, grinding to the point of liberation of the coating does not solve the problem, inasmuch as the flotation behavior of the liberated copper mineral in such a finely divided state is not predictable.

As a result of our findings, the Stamford, Conn. laboratory of the American Cyanamid Co. began a study of the feasibility of dissolving this coating by cyanidation, thus liberating pyrite which could be discarded with the tailings, refloating the concentrate and subsequently raising the grade.

Test results showed that in dissolving as little as 0.8% of the copper in the concentrate, sufficient pyrite could be rejected to raise the concentrates to well over 42%. By regenerating the cyanide, all the dissolved copper is recovered, together with over 50% of the cyanide. Consumption of cyanide is less than 1 lb per ton of ore.

The problem of rimming is not characteristic of only this particular mine, but is prevalent wherever there are zones of secondary enrichment. Even in the same orebody the amount of rimming may vary, but with the above-described method, concentrates from any given operation may be treated to give a product of more uniform copper content, thus aiding the smelter man in his calculations of fluxing material, fuel consumption and ultimate production.

An additional advantage of such a process is found in freight savings where smelters are not located on the property and long hauls at high freight rates are encountered.

PLATE NO. 7
Origin: Mine A, Chile
Particle size: minus 200- to plus 325-mesh
Magnification: 325 diameters
Identification: head sample—limestone with disseminated bornite (purple), covellite (blue), chalcopyrite (golden yellow)

Mine A ore was reported to average about 36 lb of copper per ton, of which less than 6 lb have been recovered into a marketable concentrate. A rather high percentage of bituminous material would float in a test cell without promoter and was removed as an apparent concentrate. While a large portion floated as such, the bituminous material persisted through the flotation with copper promoters.

Inasmuch as the preconcentrate upon assay was found to contain about the same amount of copper as the heads, it was felt that in some way the black bituminous material was inhibiting the flotation of the copper minerals. Investigation then proceeded along the lines of either dispersion of the bituminous material or its depression.

The investigation took a long time and went through the gamut of all the well known depressants, dispersants, and non-sulphide promoters, but without positive results. Only after years of futile effort on the part of many investigators was the sample submitted for microscopic study.

During the course of the study a representative sample was ground to 100% minus 35 mesh, screened, briquetted, polished, examined under the microscope, and particle counts made. On all sizes down to 325 mesh, there was found a preponderance of locking or dissemination of the copper minerals into both the limestone and the bituminous shale.

The minus 325-mesh fraction was then elutriated and a minus 325-mesh to plus 5-micron fraction was isolated and examined. Dissemination still persisted at this fine size. Counts of the sized fractions coarser than 325 mesh showed that only 15% of the copper minerals was liberated—the most severe case of dissemination that the author has ever encountered. It is one illustration of a problem on which microscopic analysis in the beginning could have saved a great deal of both money and time-consuming test work.

PLATE NO. 8
Origin: Mine B, Chile
Particle size: minus 200- to plus 325-mesh
Magnification: 325 diameters
Identification: tailings—disseminated chalcopyrite, bornite, and covellite in siliceous gangue

The tailings from the plant carry from 0.25 to 0.35% total copper, of which a considerable portion reports as non-sulphide copper in a chemical analysis. In an attempt to identify the oxide minerals which were contributing to this high non-sulphide assay, it was found that, instead of oxide minerals, a certain portion of the siliceous gangue carried finely disseminated sulphide minerals which could not be liberated until the particles were ground to about one micron.

It has been found that finely divided sulphides after being prepared for assay (i.e., oven-dried and pulverized) will often be soluble in the weakest solvents used in the determination of non-sulphide coppers. It is regrettable that the microscope did not reveal a method for extracting that additional amount of copper. It did, however, point out that in the light of our present-day knowledge of grinding, it would not be economic to attempt recovery of this material, and research could be directed to projects with more possibility of solution.

PLATE NO. 9
Origin: Mine B, Peru
Particle size: minus 48- to plus 65-mesh
Magnification: 80 diameters
Identification: rougher concentrate—pyrite (yellowish white) with covellite (blue) coating and filling the fractures

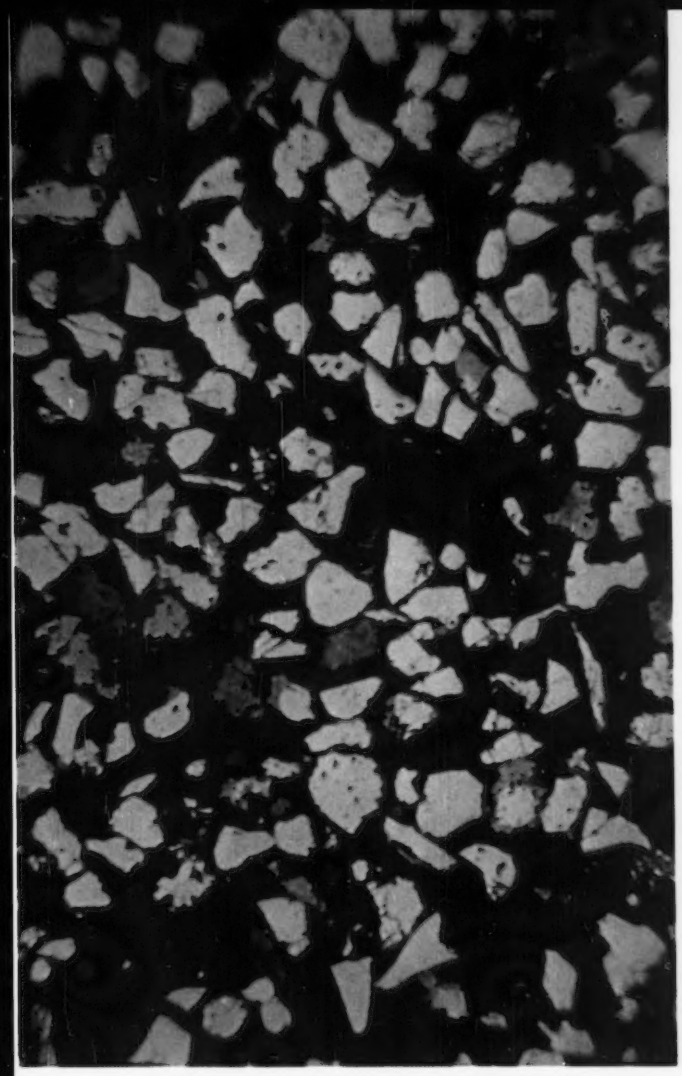


PLATE NO. 4—Mine A, Peru. Copper concentrate, minus 200 to plus 325 mesh at 80 diameters, shows pyrite (yellow white), covellite (deep blue), chalcocite (blue-gray), chalcopyrite (golden yellow) and siliceous gangue (dull gray). Enlarged 5x.

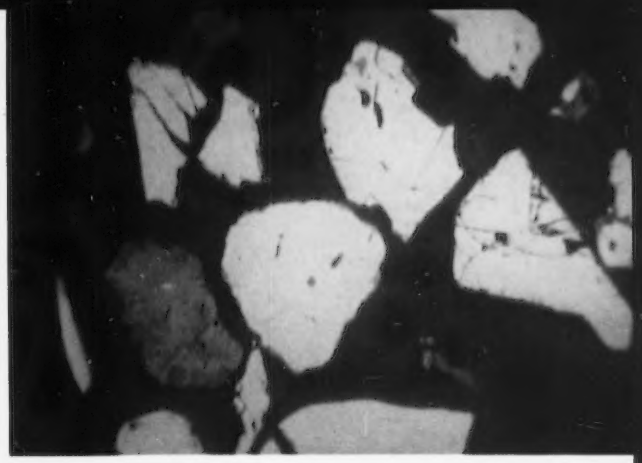


PLATE NO. 5—Same mine, same copper concentrate at 325 diameters. Plate No. 5 shows preponderance of pyrite in sample assaying only 30.8% Cu. At 325 diameters, a faint blue rim of covellite can be seen rimming the pyrite particles. Enlarged 3x.

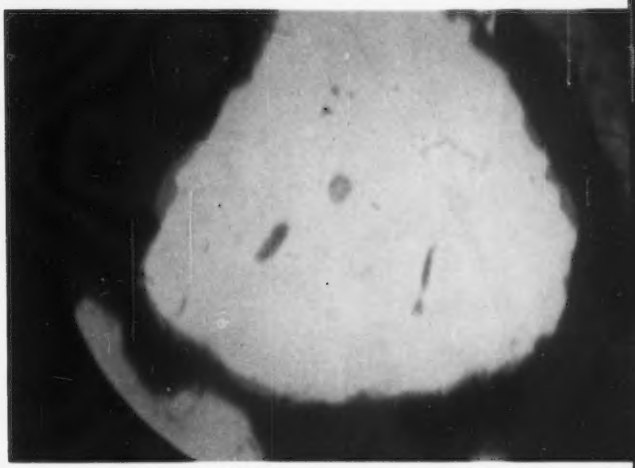


PLATE NO. 6—Same sample at 800 diameters explains why some pyrite floats. Covellite coating varies from a fraction of a micron to 20 microns in thickness. Cyanide leach removed the covellite, and a refloat raised grade to 42% Cu. Enlarged 3x.

PLATE NO. 7—Mine A, Chile. Limestone, minus 200 to plus 325 mesh at 325 diameters, with disseminated bornite (purple), covellite (blue) and chalcopyrite (yellow). Only 15% of the copper can be freed by grinding through 325 mesh. Enlarged 3x.

PLATE NO. 8—Mine B, Chile. Tailings, minus 200 to plus 325 mesh from flotation, 325 diameters, show chalcopyrite, bornite and covellite in siliceous gangue. No matter how fine the ore is ground, this locked copper cannot be recovered. Enlarged 3x.

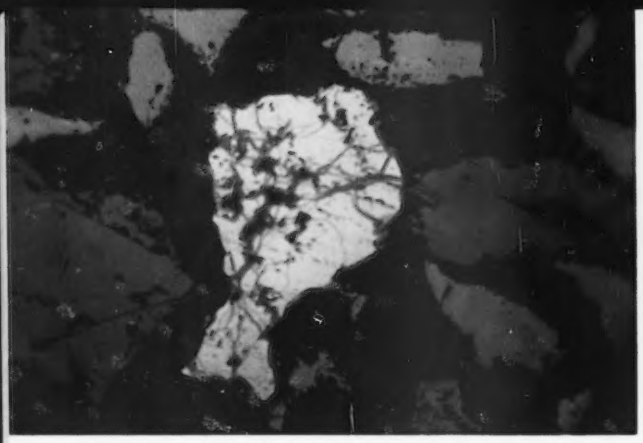


PLATE NO. 9—Mine B, Peru. Rougher concentrate, minus 48 to 65 mesh at 80 diameters, showing pyrite with coatings and fractures of blue covellite. Cyanide leach can remove covellite so that flotation will give good pyrite concentrate. Enlarged 3x.

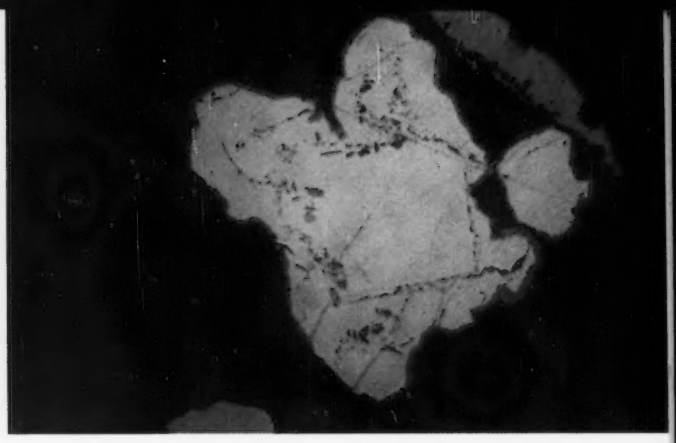


PLATE NO. 10—Mine D, Chile. Copper concentrate, minus 200 to plus 325 mesh at 320 diameters, shows covellite-coated pyrite particle that assays about 2.5% Cu. This particle will float in a copper circuit as if it were a copper mineral. Enlarged 3x.

PLATE NO. 11—Mine E, Chile. Copper concentrate, minus 200 to plus 325 mesh at 320 diameters, reveals secondary enrichment of blue covellite in yellowish-gold host mineral (chalcopyrite) tending to enrich final copper concentrate grade. Enlarged 3x.

PLATE NO. 12—Mine B, Chile. Copper concentrate, minus 200 to plus 325 mesh at 320 diameters. There are several deposits of this type along the west coast of South America in which pyrite is not coated by secondary coppers to any extent. Enlarged 3x.

PLATE NO. 13—Mine C, Peru. Bulk Cu-Pb, minus 200 to plus 325 mesh at 320 diameters, reveals that no amount of grinding will separate blue covellite from galena. Further attempts to separate these would be a waste of time and money. Enlarged 3x.

PLATE NO. 14—Mine D, Peru. Bulk Cu-Pb, minus 65 to plus 100 mesh at 120 diameters, illustrates a galena particle partially replaced by blue covellite. Regrind would be recommended to produce both a high-grade lead and copper product. Enlarged 3x.

PLATE NO. 15– Mine C, Peru. Locked particles from Cu-Pb bulk, minus 150 to plus 200 mesh at 320 diameters. Sphalerite (dull gray), covellite (blue), chalcopyrite (yellow) and galena (white) require both a regrind and a cyanidation. Enlarged 3x.

PLATE NO. 16– Mine E, Peru. Bulk Pb-Cu, minus 150 to plus 200 mesh at 320 diameters, displays marmatitic sphalerite (gray) with a blue covellite rim and fracture replacement. Regrind would not improve flotation results to any great extent. Enlarged 3x.

PLATE NO. 17– Mine D, Peru. Pseudomorph of covellite (deep blue) and digenite (lighter blue) after galena, minus 200 to plus 325 mesh at 800 diameters. Digenite is a copper sulphide mineral and pure crystals or masses are extremely rare. Enlarged 3x.

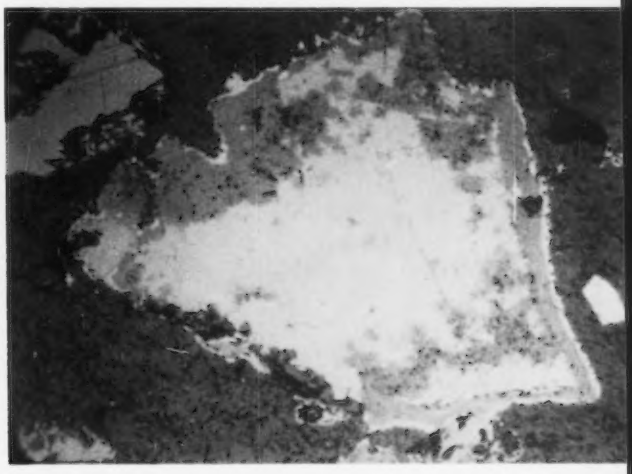


PLATE NO. 18– Mine E, Peru. Bulk Pb-Cu, minus 200 to plus 325 mesh at 800 diameters. Again, rigid pH and reagent control cannot hope to reduce the zinc content of a lead or copper concentrate. Cyanide is being tested as a solution. Enlarged 3x.

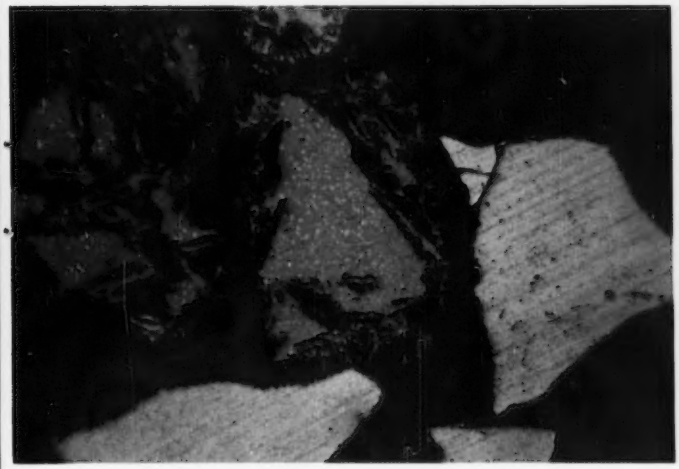


PLATE NO. 19– Mine E, Peru. Sphalerite, minus 200 to plus 325 mesh at 320 diameters, with chalcopyrite (yellow) inclusions. Chalcopyrite in zinc concentrates means a loss of earnings for the copper and silver in the ore to the producer. Enlarged 3x.

PLATE NO. 20– Mine A, Bolivia. A rather complex ore, minus 200 to plus 325 mesh at 800 diameters, in which blue cuprite (oxide), light-gray malachite (carbonate), metallic copper and blue-white chalcocite (sulphide) occur together. Enlarged 3x.

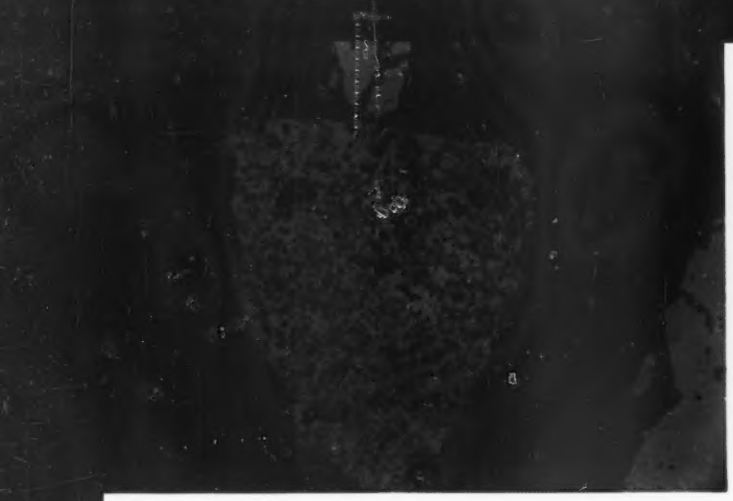


PLATE NO. 21—Mine F, Peru. Melnikovite, a colloidal pyrite, 150 mesh at 300 diameters. Plates 21 through 25 illustrate a difficult problem in an ore containing enargite, luzonite, chalcocite and covellite. See plate below for more data. Enlarged 3x.

PLATE NO. 24—Same mineral, ground minus 325 mesh to plus 20 microns at 500 diameters. One other mineral encountered only in Popo, Bolivia, by the author has the same structure—cylindrite, a rare sulphide mineral containing both lead and tin. Enlarged 3x.

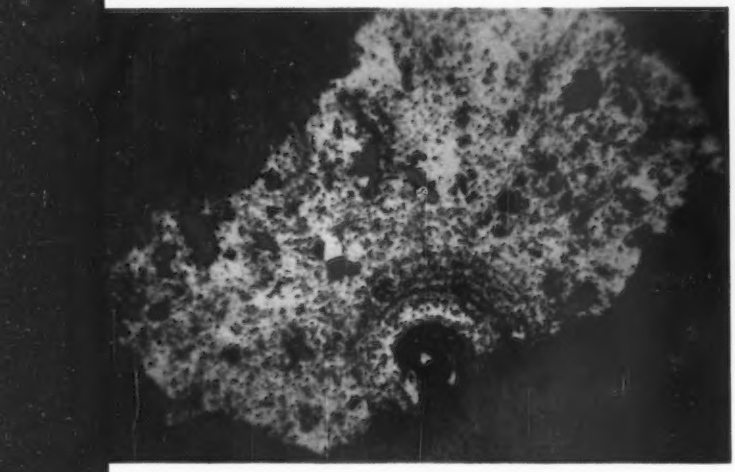


PLATE NO. 22—Same mine, same sample, ground minus 325 mesh to plus 20 microns at 500 diameters. Rimming by secondary coppers is at a minimum. Copper values are not highly disseminated within either the gangue or pyrite minerals. Enlarged 3x.

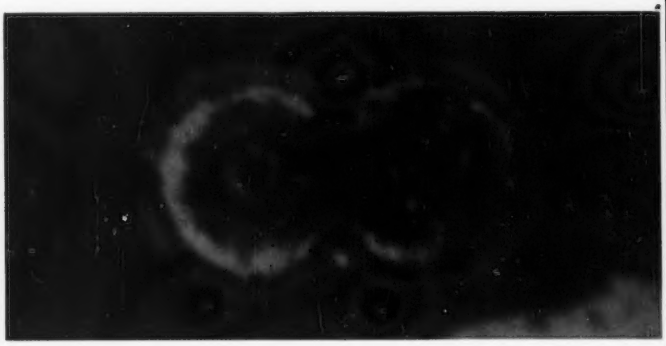


PLATE NO. 25—Same mineral, ground minus 325 mesh to plus 20 microns at 1250 diameters. The author found this pseudomorph of covellite and chalcocite after melnikovite in which the concentric rings had been replaced by coppers. This may reveal a method of separating melnikovite – by preactivating it with a copper salt and floating it away, after which the copper minerals could be separated. Being a colloid, melnikovite absorbs all depressants, regulators and activators and in general is unpredictable during the normal process of flotation. Enlarged 8x.

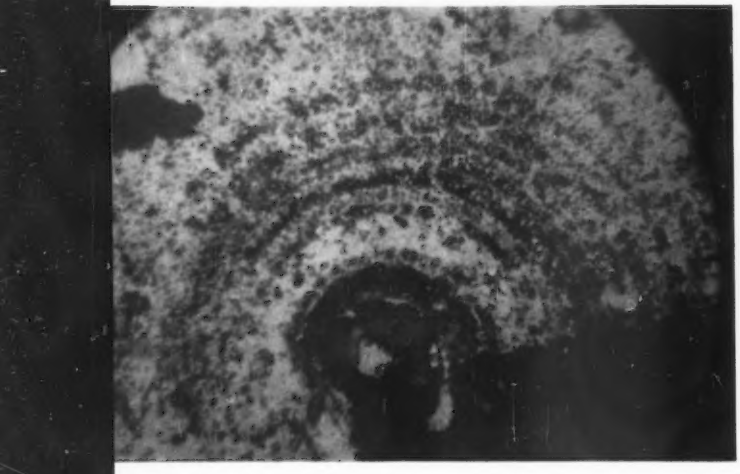


PLATE NO. 23—Same mineral, ground minus 325 mesh to plus 20 microns at 1250 diameters. Circular mineral, melnikovite, is found in several mines in the vicinity, but is not very common and good specimens are extremely hard to find. Enlarged 3x.

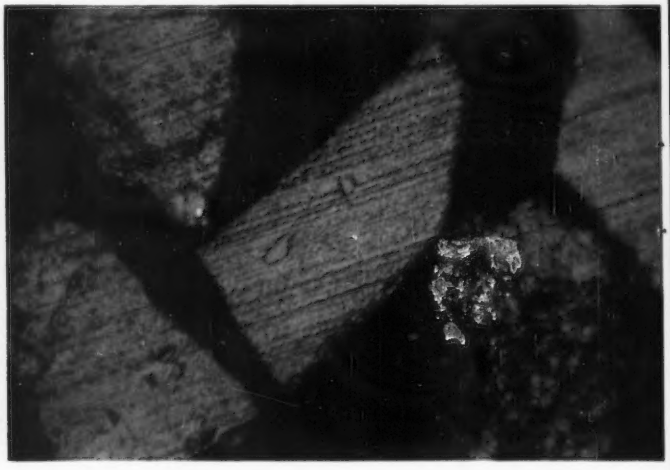


PLATE NO. 26—Mine G, Peru. Pyrite-striated gold, ground minus 325 mesh to plus 20 microns at 800 diameters, highly polished. Roasting the pyrite (9 gm Au per ton) would break up the crystals to liberate some gold for cyanidation. Enlarged 3x.

A photo was taken to show the fallacy of always resorting to regrind to produce a pyrite that can be depressed by the aid of either high pH, cyanide, or any of the other pyrite depressors. Regrinding here would only produce more particles, each with coatings of covellite, even in the finest sizes. If the coating is partially removed, the resulting copper may or may not be floatable.

By chemically removing the coating, the copper is in a recoverable form (by cementation) and the pyrite has been cleaned of its adhering film so that it may be depressed with the reagents available. The free, coarse chalcocite and covellite will float into a high-grade shippable concentrate.

PLATE NO. 10
Origin: Mine D, Chile
Particle size: minus 200- to plus 325-mesh
Magnification: 320 diameters
Identification: copper concentrate—pyrite (yellowish white), covellite (blue)

What we have here is a particle of pyrite completely coated with covellite. Measurements were made with a planimeter and the volume of the copper mineral calculated. Using the theoretical value for covellite, it shows that the particle would assay about 2.5% Cu and, like many more, would float into the concentrate as if it were solid copper mineral, thus producing concentrates far below the theoretical anticipated grade based on mineralogical content of the ore.

PLATE NO. 11
(See four-color section for details.)

PLATE NO. 12
(See four-color section for details.)

PLATE NO. 13
Origin: Mine C, Peru
Particle size: minus 200- to plus 325-mesh
Magnification: 320 diameters
Identification: bulk Cu-Pb concentrate—galena (white), covellite (blue)

Copper mills by no means have a corner on the problems of secondary enrichment coatings as revealed by the microscope. Plate No. 13 represents a great many similar particles in this bulk concentrate, which show that fine grinding at any reasonably economic mesh size would never free the one mineral from the other and allow separation of the two.

In many cases the microscopist is consulted only about methods of separation after the conventional methods have been tried and failed. Here again it is regrettable that even the microscope does not reveal a method, but it does reveal the impracticability of using any concentration method known today, as long as such intimate intergrowths persist in this portion of the orebody.

PLATE NO. 14
Origin: Mine D, Peru
Particle size: minus 65- to plus 100-mesh
Magnification: 120 diameters
Identification: copper-lead bulk concentrate—galena (white) covellite (blue)

The particle of galena which has been partially replaced by covellite represents a concentrate that, with adequate grinding, can usually be split into both a high-grade concentrate of free galena and a high-copper concentrate. A regrind of the bulk concentrate could be recommended. To be sure, many concentrates are produced with both free copper and lead minerals, but the separation is well known and works reasonably well; so well, in fact, that they are seldom brought to the attention of the microscopist.

PLATE NO. 15
Origin: Mine C, Peru
Particle size: minus 150- to plus 200-mesh
Magnification: 320 diameters
Identification: a locked particle from the bulk Pb-Cu concentrate consisting of sphalerite (dull gray) with a coating of covellite (blue); in the center, covellite and chalcopyrite (yellowish gold); and galena (white)

The particle represents a large group of minerals in a deposit which are both locked and coated; one in which both regrind and cyanidation would be required to give any degree of freedom in the production of clean concentrates of any of the individual minerals.

PLATE NO. 16
(See four-color section for details.)

PLATE NO. 17
Origin: Mine D, Peru
Particle size: minus 200- to plus 325-mesh
Magnification: 800 diameters
Identification: pseudomorph of covellite (deep blue) and digenite (lighter blue) after galena

PLATE NO. 18
Origin: Mine E, Peru
Particle size: minus 200- to plus 325-mesh
Magnification: 800 diameters
Identification: bulk Pb-Cu concentrate—sphalerite (gray) rimmed with covellite (blue)

These particles illustrate why in many cases a lead or copper concentrate runs high in zinc in spite of rigid reagent (depressant) and pH control. Tests are being made with cyanide leaching of this type material to provide clean sphalerite for ultimate depression in a lead or copper circuit and subsequent recovery in its own circuit.

PLATE NO. 19
Origin: Mine E, Peru
Particle size: minus 200- to plus 325-mesh
Magnification: 320 diameters
Identification: sphalerite (gray) with inclusions of chalcopyrite (yellowish gold)

Plate No. 19 explains several very troublesome occurrences in the field of zinc flotation. One is the high copper content of zinc concentrates. Inasmuch as the copper is lost or at least not paid for by the smelting companies, there is a loss to the producer. Another loss is in misplaced silver, since zinc smelting companies pay less for the silver in the zinc than in the lead concentrates.

As chalcopyrite contains within its crystals certain amounts of silver, we can often calculate the silver content of the zinc concentrate by the copper assay; the ratio of copper to silver will be the same as in the lead concentrate.

Although this offers no means of putting the valuable metals in the concentrates where they will return most to the mill operator, it does solve the mystery as to why these metals land in this concentrate; and shows that with any means known today it is infeasible to attempt cleaning the concentrate to get the metals in the most profitable position.

Another source of trouble given by this unusual combination is that under oxidizing conditions due to either conditions in the mine or during treatment in the mill, the chalcopyrite inclusion on the surface of the particle may oxidize, thus activating the sphalerite and causing it to float into the lead concentrate where the zinc is as unwelcome as are copper and silver in the zinc concentrate.

PLATE NO. 20
(See four-color section for details.)

PLATES NO. 21, 22, 23, 24, AND 25
Origin: Mine F, Peru
Particle size: Plate No. 21, 150-mesh; others, minus 325-mesh to plus 20 microns
Magnifications: Plate No. 21, 300 diameters; Plate No. 22, 500 diameters; Plate No. 23, 1250 diameters; Plate No. 24, 500 diameters; Plate No. 25, 1,250 diameters
Identification: melnikovite, a colloidal pyrite

One very interesting problem which was revealed only at very high magnification is shown in this series of plates. The ore was very resistant to concentration. No amount of collector, depressant or activator, not to mention fineness of grinding, could seem to produce a concentrate of shipping value, and yet the principal minerals of the ore are enargite, luzonite, chalcocite and covellite. Particle rimming with secondary minerals is at a minimum.

From a logical standpoint it seemed that perhaps the valuable copper minerals were highly disseminated within either the gangue or within the pyrite, but microscopic examination failed to show this even under high magnification.

At a low magnification of 80 diameters, some strange particles as noted on Plate No. 21 were found. It will be noted that the particle contains some circular areas which are truly uncommon in the field of mineralogy. Many particles in the briquette contained this same structure and it put the author at a great disadvantage, since so few minerals with circular structure are described in the texts.

However, one other mineral that I had encountered had somewhat the same structure (cylindrite). It is a rare bird found only in Popo, Bolivia, and is described as a lead-tin sulphide.

A microscopic examination of cylindrite showed this same circular formation. By sheer coincidence the description and name of the unknown mineral (melnikovite) in Plate No. 21 were found in a German text. A search through the various briquettes showed particles with numerous concentric rings, as exhibited on Plate No. 22 and No. 23, and by rare coincidence (Plate No. 24) a section of one of these cancerous growths (i.e., a section cut through the center and parallel to the axis) was found and photographed.

Also in the study of the problem we found a pseudomorph of covellite and chalcocite after melnikovite (Plate No. 25), in which the concentric rings have been replaced by copper minerals. This may actually reveal a method of separating the melnikovite—by pre-activating with a copper salt and removing by flotation, after which the copper minerals could be separated.

It is worth noting that ore from other mines in the immediate vicinity, where separating efficiencies were quite low, showed certain amounts of melnikovite. It is not common, however, and good specimens are quite rare, but in instances of high pyrite content in which the pyrite resists polishing (i.e., has a very fragile structure), melnikovite is very apt to exist. As a colloid, melnikovite seems to absorb all depressors, regulators, and activators, and in general produces unpredictable flotation results.

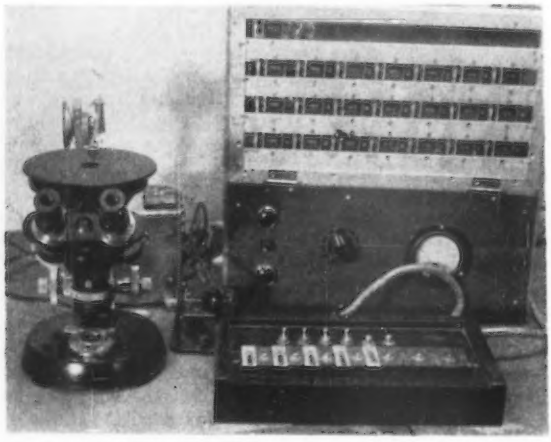
PLATE NO. 26
Origin: Mine G, Peru
Particle size: minus 325-mesh to plus 20 microns
Magnification: 800 diameters
Identification: a pyrite concentrate—pyrite-striated gold, high polish

The sample was submitted as a pyrite concentrate floated from the tailings of a cyanidation plant. It was said to contain 9 grams of gold per ton. The problem was to determine the location of the gold and recommend a method for its extraction. Briquettes of the material were made and polished. With the finest polish that we were able to give the briquette, we were never sure that we could see any gold. To be sure, there were inclusions in the pyrite which marked a difference in the polished surface.

Polarized light showed that the inclusions were all seemingly isotropic and with little or no difference in reflecting properties. The particles were too small to try hardness or microchemical tests—so, in a moment of desperation, the entire briquette was placed in a watch glass containing a 50-50 nitric acid-water mixture and allowed to soak for several minutes, after which the briquette was washed off and again viewed under the microscope.

The pyrite was deeply etched along scratch lines, but the gold was not affected. Although to locate 9-gram gold in a concentrate is no easy job, since it does involve some considerable search, we were able to find enough instances, as shown in Plate No. 26, to substantiate the assay value of the gold and point out that only by roasting the pyrite concentrate could the crystals be broken down sufficiently to liberate the gold.

Special Counter Speeds Microscopic Analysis



THERE MAY BE a great many devices for counting and recording particles. I have seen one other in addition to the one developed in this laboratory and herein described.

We developed the machine for certain specific functions. First of all, we wanted to know the approximate percentages of the various minerals on any one screen size and, secondly, the percentages of free and locked minerals. Actual particle counts of an entire field of vision are tedious and not too exact unless counts of many thousands are made.

The microscope used for our counter is a Carl M. Zeiss Standard Metallographic with a sliding stage rather than a revolving one. A variable speed motor of slow speed

PLATE NO. 27—The author developed the particle counting and recording machine so that he could determine the approximate percentages of the various minerals in any one screen fraction, and percentages of free and locked minerals.

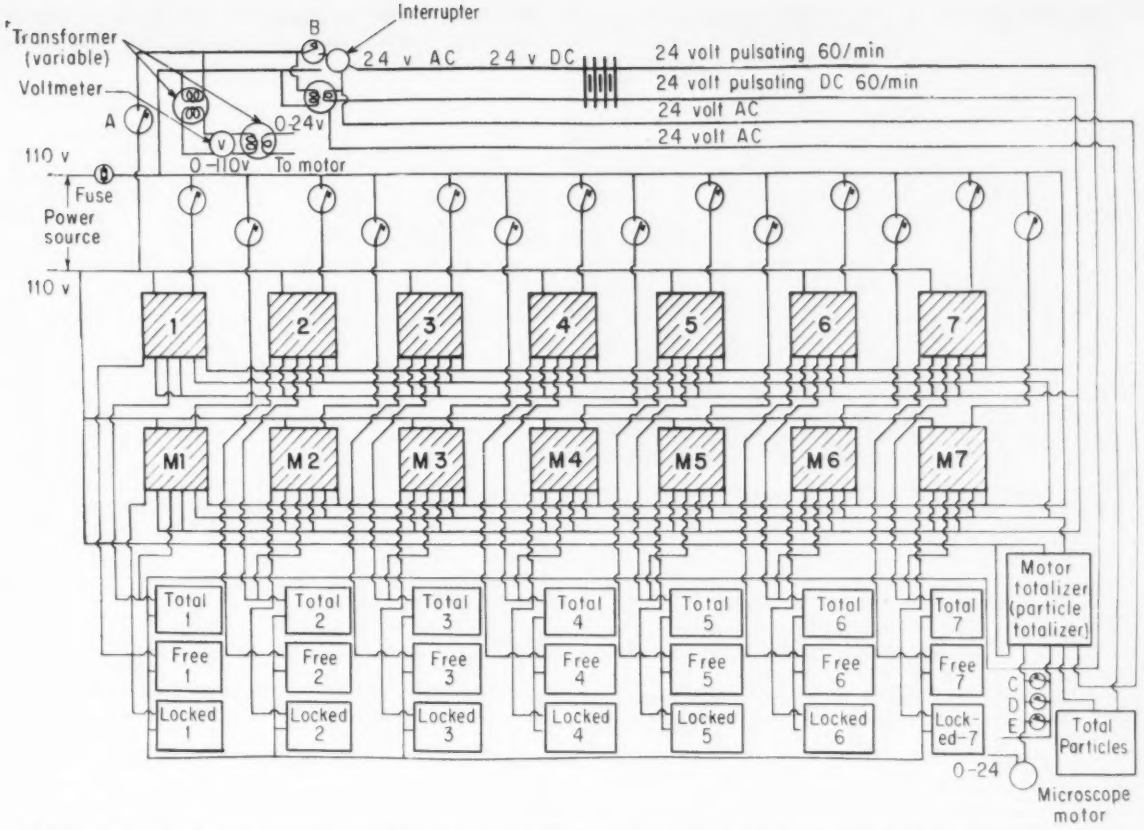


PLATE NO. 28—Particle counting machine has a variable transformer and voltmeter within the body to permit the operator to set and record the scanning speed. Then, on a recount, he can duplicate the speed. Attached to the counter by multiple conductor cable is a keyboard with 14 keys—seven for the free minerals and seven for the locked ones. Seldom is one mill product found with more than seven minerals. The machine records lineal distance traversed, a measure of area and volume.

(1/8 to 1/20 rpm) is attached to the microscope and moves the briquette through the field of vision at the rate of speed convenient for counting. We have provided a variable transformer and voltmeter within the body of the counting machine; thus we may set and record the speed so that on a recount we can duplicate the speed.

Attached to the counting machine by multiple conductor cable is a keyboard with 14 keys—seven for the free minerals and seven for the locked minerals. We seldom find any mill product with more than seven minerals, and, if so, we group two or three (as pyrite and sphalerite) and make a double count. For instance, if the pyrite and sphalerite content is 30% and on the recount the pyrite and sphalerite show a 60-40 relationship, then we know that they represent 18% and 12%, respectively, of the total.

Actually, in the machine we are recording lineal distance traversed, which on particles of nearly the same size such as those between screen sizes, gives us the approximate area and volume of the individual minerals—or at least the relationship between them. During the counting the minerals must, of course, be readily identified; this is not the time to make mineral identifications.

Prior to counting and for the identification, we use the Zeiss Petrographic Microscope on both thin sections and polished sections where it is important to have polarized light. For scratch tests as well as microchemistry, we use the Zeiss Stereoscopic Microscope. For the identification of gangue minerals, thin sections are made or powders are imbedded in Canada Balsam.

It is the general policy to scan 400 to 500 particles, thus traversing the briquette at least four times in one direction, and then to rotate it through 90 deg and scan four times in the other direction. A space of at least three times the diameter of the largest particle is left between scanning lines.

Plate No. 27 shows the front view of the recording machine and Plate 28 is a schematic diagram of the apparatus. On the top row at the extreme left (Plate No. 27) is one counter which records the total distance traversed over all particles. The first row of seven counters records the distances traversed on each individual mineral which is not free, while the second row records the distance traversed on individual free minerals. The third row records the totals of each mineral, or the sum of rows one and two.

Before setting the counters at zero we make a trial run by going over a section and selecting the objective lens for the best magnification, then setting the speed of the microscope plate so that the average size particle will take about two or three seconds of travel. The variation in speed is accomplished by varying the primary voltage to the microscope motor.

While the right hand is used to depress the keys on the recorder, the left hand operates the fine adjusting knob and keeps the briquette in focus at all times (see Plate No. 29). Slight variations of the sliding mechanism may vary the focus, but are compensated by this control. Also, during this preliminary scanning we select the most commonly occurring mineral (such as gangue in a head

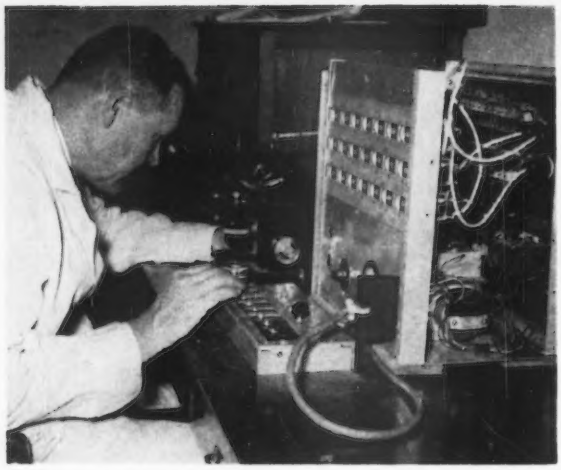


PLATE NO. 29—The right hand is used to depress keys on the recorder, while the left hand operates the fine adjusting knob and keeps the briquette in focus at all times. Most common mineral is selected as number one for scanning routine.

or tail sample) to designate as the number one mineral.

Pyrite, which may be the next most common mineral, would be number two, and so on. This information is put on a card and can be referred to as the scanning progresses, since it is extremely difficult to keep seven keys with their respective minerals in mind throughout the scanning.

All counters are then set at zero and the scanning is started in the upper left hand quadrant. To pass the briquette through the crosshairs when passing over the plastic matrix, we have provided a foot throttle as well as a button (normally off-momentarily on) on the keyboard. This operates the motor independently of the recording device. The keyboard has cantilever keys for free minerals and buttons between the cantilevers for the locked minerals; thus a touch system can be developed and it is not necessary to remove the eye from the microscope during the counting.

There are occasions when a particle will be observed which is locked with another mineral but only one mineral actually passes through the crosshairs. This is recorded as a locked particle of the mineral passing. No note of the other mineral is made. If enough particles are scanned this situation will undoubtedly occur again in the reverse order.

The point is that enough mineral particles must be counted and observed so that one more will not throw the percentage off. To check our results, we have scanned until we have passed a total of 200 units, recorded the mineral counts and calculated the percentages. After that we stopped at intervals of 100 units, until 1,000 was reached. We found a certain variation below 500 units, but after that the averages of the mineral counts, with slight variation, assume a constant representing the mineralogical percentages of that sample.

There are other occasions when we encounter minerals within the field of vision but which do not come into the crosshairs; such are noted for the record as traces. The chances that a significant quantity of any mineral would avoid passing through the crosshairs and thus be missed in the counting are quite remote.

This counting method is not to be construed as a substitute for chemical analysis. However, on many occasions calculations have been made of metal content based on the theoretical composition of the minerals as recorded, and this has checked with very acceptable accuracy with

Case 1: Sulphides identified as bornite (1.0%), covellite (1.6%), chalcopyrite (2.4%), and pyrite

Mine No. 1

Briquette No. 1—minus 28- to plus 35-mesh heads

	Percentages		
	Locked	Free	Total
Gangue	65.0	25.0	90.0
Pyrite	5.0	0.0	5.0
Chalcopyrite	2.4	0.0	2.4
Covellite	1.6	0.0	1.6
Bornite	1.0	0.0	1.0
	75.0	25.0	100.0

Briquette No. 2—minus 35- to plus 48-mesh heads

	Locked	Free	Total
Gangue	5.0	85.0	90.0
Pyrite	4.5	0.5	5.0
Chalcopyrite	2.4	0.0	2.4
Covellite	1.6	0.0	1.6
Bornite	1.0	0.0	1.0
	14.5	85.5	100.0

Briquette No. 3—minus 48- to plus 65-mesh heads

	Locked	Free	Total
Gangue	3.0	87.0	90.0
Pyrite	4.0	1.0	5.0
Chalcopyrite	2.2	0.2	2.4
Covellite	1.6	0.0	1.6
Bornite	1.0	0.0	1.0
	11.8	88.2	100.0

Briquette No. 4—minus 65- to plus 100-mesh heads

	Locked	Free	Total
Gangue	1.0	88.0	89.0
Pyrite	3.5	2.5	6.0
Chalcopyrite	2.1	0.3	2.4
Covellite	1.4	0.2	1.6
Bornite	0.5	0.5	1.0
	8.5	91.5	100.0

Briquette No. 5—minus 100- to plus 150-mesh heads

	Locked	Free	Total
Gangue	0.0	88.0	88.0
Pyrite	3.0	4.0	7.0
Chalcopyrite	2.0	0.4	2.4
Covellite	1.4	0.2	1.6
Bornite	0.4	0.6	1.0
	6.8	93.2	100.0

Briquette No. 6—minus 150- to plus 200-mesh heads

	Locked	Free	Total
Gangue	0.0	86.3	86.3
Pyrite	0.5	6.5	7.0
Chalcopyrite	2.0	1.5	3.5
Covellite	1.6	0.4	2.0
Bornite	0.2	1.0	1.2
	4.3	95.7	100.0

Summary

1. Plus 35 mesh shows sulphide-gangue locking 65%
2. Plus 48 mesh shows sulphide-gangue locking 5%
3. Plus 65 mesh shows sulphide-gangue locking less than 4%
4. However, pyrite-chalcopyrite shows strong locking until 200 mesh is reached
5. Percent gangue on all screen sizes is never less than 86%
6. Some pyrite disseminated in gangue
7. Secondary covellite on chalcopyrite and bornite

Possible conclusions

1. Initial grind, 100% passing 48 mesh
2. Bulk float all sulphides, with liquid Aerofloat® Promoter or Aero® Xanthate. No pH control necessary except for froth stabilization
3. Regrind bulk concentrate to 100% passing 200 mesh
4. Selectively float copper minerals at high pH with possible use of cyanide

Possible limits

1. Plus 90% recovery; plus 40% Cu grade

Case 2: Sulphides identified as bornite, covellite, chalcopyrite, and pyrite

Mine No. 2

Briquette No. 7—minus 28-to plus 35-mesh heads

	Percentages		
	Locked	Free	Total
Gangue	30.0	5.0	35.0
Pyrite	56.0	2.0	58.0
Chalcopyrite	4.0	0.0	4.0
Covellite	1.5	0.0	1.5
Bornite	1.5	0.0	1.5
	93.0	7.0	100.0

Briquette No. 8—minus 35-to plus 48-mesh heads

	Locked	Free	Total
Gangue	4.0	30.0	34.0
Pyrite	57.0	2.0	59.0
Chalcopyrite	4.0	0.0	4.0
Covellite	1.5	0.0	1.5
Bornite	1.5	0.0	1.5
	68.0	32.0	100.0

Briquette No. 9—minus 48-to plus 65- mesh heads

	Locked	Free	Total
Gangue	3.0	30.0	33.0
Pyrite	5.0	55.0	60.0
Chalcopyrite	4.0	0.0	4.0
Covellite	1.5	0.0	1.5
Bornite	1.5	0.0	1.5
	15.0	85.0	100.0

Briquette No. 10—minus 65-to plus 100-mesh heads

	Locked	Free	Total
Gangue	1.0	29.0	30.0
Pyrite	35.0	28.0	63.0
Chalcopyrite	3.5	0.5	4.0
Covellite	1.5	0.0	1.5
Bornite	1.5	0.0	1.5
	42.5	57.5	100.0

Briquette No. 11—minus 100-to plus 150-mesh heads

	Locked	Free	Total
Gangue	0.0	29.0	29.0
Pyrite	23.0	40.0	63.0
Chalcopyrite	4.0	1.0	5.0
Covellite	1.5	0.0	1.5
Bornite	1.0	0.5	1.5
	29.5	70.5	100.0

Briquette No. 12—minus 150-to plus 200-mesh heads

	Locked	Free	Total
Gangue	0.0	25.0	25.0
Pyrite	2.0	63.0	65.0
Chalcopyrite	0.5	5.5	6.0
Covellite	1.5	0.5	2.0
Bornite	1.0	1.0	2.0
	5.0	95.0	100.0

Summary

1. At 35 mesh, sulphide-gangue locking 30%
2. At 48 mesh, sulphide-gangue locking less than 5%
3. At 65 mesh, sulphide-gangue locking less than 4%
4. Chalcopyrite-pyrite locking until 200 mesh
5. Percent gangue on all screen sizes never exceeds 35%

Possible conclusions

1. Initial fine grind to 150 mesh. No advantage in discarding gangue at coarse grind
2. Initial selective flotation with Aerofloat® 238 Promoter

Possible limits

1. 90% recovery; 25% Cu concentrate

a chemical analysis. Indeed, the results in so many cases are so much more valuable than chemical analysis that we see no reason for pitting one against the other; the scanning results tell such things as whether the minerals of the valuable metal appear in the tailings by virtue of poor flotation, locking, dissemination, or other causes.

In some cases I have known people to believe that their zinc was marmatitic purely because they could not produce a high-zinc-low-iron concentrate, when in truth it was found that the concentrate contained as much as 15% free pyrite which, if removed, would have resulted in a high-grade sphalerite concentrate. This is but one of many questions that the chemist cannot answer from his routine analysis.

The foregoing has indicated the general procedures followed. For dealing with the problems of the operating plant it is well to take samples of the classifier overflow, concentrates, and tailings, together with any intermediate products, to screen and analyze them. If done periodically, such as in a weekly or monthly composite, any tendencies toward different separating efficiencies will show up, as well as any changes in the ore.

Mineralogy of refractory ores will show up and measures to combat, correct, or eliminate problems can be planned. It would also be well if comparisons could be made with the operations of other mills treating similar ores. However, only through the aid of the microscopic technique can any comparison be made; it can readily be seen that comparing the operations of two mines treating 1.5% Cu ore would have little or no value. Such comparison would only be of value if the two plants treated the same type of mineral with the same gangues, locking, etc.

To set up a routine microscopic and mineralogical examination for any property, it is desirable to select, first, enough hand specimens representing the minerals occurring in the mine, to briquette and polish these to a point where, if any minerals are not readily identifiable by color or structure, microchemical or polarized light tests can be made to identify them positively. After frequent references to the hand specimens, the microscopist becomes well acquainted with the minerals from any one deposit, thus gradually eliminating doubts as recording progresses.

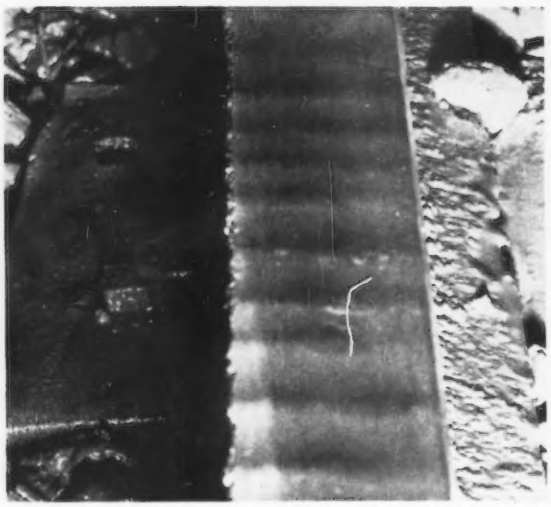
For the new prospect, a sample that is as representative as possible should be taken. This should be ground to produce material on all screen sizes from 35-mesh to the finest. Each of the fractions should be handled in the same way as described above and mineralogical counts made. A great deal may be prognosticated on possible future treatments, recovery and grade limits from this information. However, by making comparisons with other deposits having similar mineralogical combinations, many of the operating pitfalls may be avoided.

The idea is to find the economical point of liberation of the valuable minerals, using the particle counter that has also been described above. The percentages of both locked and free minerals can be determined for all screen sizes. An economic study of these results will help determine a suitable flowsheet. Two cases are presented here showing the results of microscopic analysis together with suggested treatment and limits to be expected on the basis of those results.

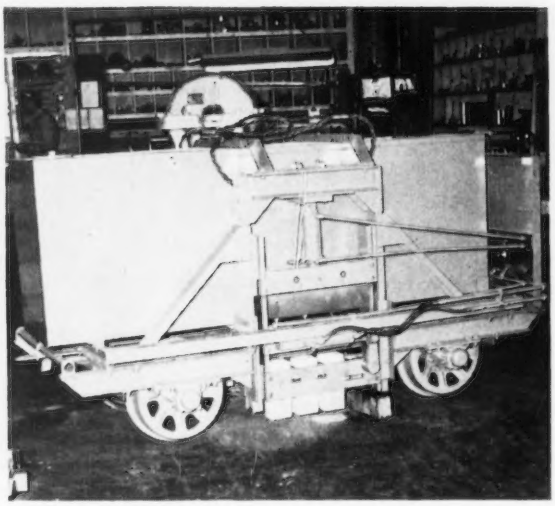
The two cases detailed are hypothetical only in the sense that the mines or mills from which the data were derived are not noted; but they are now operating. The conclusions in some cases agree with plant results and the metallurgical limits predicted have been approached in most instances.

For the new operation, such information could provide an excellent starting place for an investigation and the conclusions provide a basis for judging test results.

The following two case histories offer solutions to small maintenance problems, examples of savings through parts reclamation, and a technique for repair records keeping.



RAIL CORRUGATION was a major problem on the main haulage way. Car axles were being severely damaged.



SPECIALLY DESIGNED rail grinding machine has extended mine car life—axle breakage was cut by 90%.

How Bunker Hill Trimmed Upkeep Cost

BY HAVING their own shops repair and modify equipment, and by tightening up lubrication schedules, Bunker Hill Co.'s lead mine and smelter, Kellogg, Idaho, was able to reduce costs by a sizable amount. Monthly pump costs were cut by more than $5,0(rail unit costs by more than $1,500 a month. The company also slashed maintenance costs on muckers, hammer mill, and conveyors.

In 1956, a flood, plus a series of mine pump failures, brought out the need for a detailed study of the total pumping problem. In one way or other, most of the failures were linked to bearing failure, with the final result that frequently both pump and motor were seriously damaged. The first approach to a solution was a thorough study of lubricants and lubrication procedures. The lubricants, as received at stores, were satisfactory. However, they were badly contaminated by the time they were poured into the bearings. Nearly every can contained rust, dirt, and water.

The problem was solved by purchasing 1-qt outboard motor type oil cans, packaging the lubricant in the stores and delivering to pump stations without ever opening the containers until the oil was actually poured into the bearing housing. The company outlined proper lubrication levels, showed how to spot areas needing oil, and stressed the need for cleanliness in all phases of lubrication.

Readings of amperes, water pressure, and pH were taken each month at each of the pump stations to check for possible changes. Counters were installed on the pump motors to establish the number of times each unit was started, and hour meters indicated operating time. All pumps were equipped with bearing thermal relays and pump body thermal relays. Some pump bearing failures were traced to packing glands which, by failing, had forced water into the bearings. This was overcome by installing slingers on the pump impeller shafts.

Early this year, a remote supervisory set-up was installed on the pumping system with control and signals terminating at the No. 1 hoist bridge. The supervisory panel indicated which sump is in trouble and whether it is at high or low water level. Since the unit was installed, all pumps have had unattended, fully automatic operation. Daily inspection and lubrication, if needed, is handled by one man each shift. These corrective measures have given a total monthly saving of more than $5,000. For the first six months of 1956, the average monthly cost of pumping was $15,840. Average monthly pumping cost for the months of June and July 1958 was $8,259.

Mine rail corrugation was a major problem on the main haulage way. Grinding the rails with a specially designed machine has appreciably increased the life of cars and locomotives, as well as reduced axle breakage by 90% during the past year.

Main haulage ore cars are now being completely serviced at 6-month intervals, with bearing journals removed, inspected, cleaned, and lubricated. Once again, lost production time was reduced and the service life was extended on bearings, journal boxes, and axles.

The current maintenance schedule calls for a complete overhaul of each mine locomotive every two years, or when tires on the wheels become badly worn. Locomotives are carefully inspected at least once a week (daily for those on heavy haulage

duty), and maintenance is now largely on a preventive basis. Serious controller, gear, or motor failures are becoming less frequent.

Bunker Hill is gradually converting batteries in mine locomotives from nickel-iron-alkaline types to the lead-acid variety. The program, started in 1957, is expected to reduce costs by 30 to 40%.

For some time, the mine machine shop has been making special salvage efforts, and the following are instances of major savings.

A small mechanical part on the large hoist's lubrication pump frequently failed. The part could not be obtained and, as a consequence, the pump had to be completely replaced at a cost of $200. After studying the problem, the machine shop rebuilt parts for five discarded pumps at a cost of $81—a net saving of $919.

Mucking machine arms were being discarded because they were bent. By using a special jig, the welding shop salvaged seven sets of arms for $350, and saved the company $1,750.

When it was worn through, the cast-iron spider on top of the gyratory crushers was scrapped. A system was devised to repair the spiders at a cost of $300 (net saving—$700).

The air drill's aluminum shells were being discarded when the guides became worn. These units cost $250 each. Twelve of the liners have been rebuilt at a cost of $840, or a net saving of $2,160.

Mine car wheels and locomotive wheels are being built up on an automatic welding machine and then tooled to standard size at 50% of the cost of new wheels. On this operation alone, savings amounted to more than $1,500 a month and the automatic welder is utilized 100% of the time on hardfacing and buildup jobs.

Considerable effort is being made to standardize replacement items. One example is in conveyor belting, which is now stocked in a single location for all plants and a single specification is used for all but special applications. By careful control of the use of replacement conveyor belts, it was possible to minimize the footage carried in stock. The company keeps one length to rebelt the longest conveyor and cuts all shorter lengths from a second piece. When the shorter section is used, a replacement length is ordered for the longest piece in stock and all cutting is made on the stocked piece. Short pieces, as they accumulate, are vulcanized into a usable length.

A hammer mill at the smelter mixes sinter feed before it goes to the bedding pile. Every hour, about 200 tons of minus ¼-in. material is run through the unit. The material is very abrasive and puts great strain on breaker blocks and hammers. Breaker blocks lasted from 2 to 3 months and required a weekly buildup of wear pockets. A laminated liner was designed and cast in either white iron or Ni-hard. Liners last about eight months, and the new design makes it possible for a set of them to be replaced in about 25% of the time previously required.

The mill hammer assembly is made up of nine hammers weighing about 80 lb. Originally, solid cast hammers (work hardening alloy) were used, but these lasted only one week. To return them to usable condition, it was necessary to place about 15 lb of buildup. The company recently began using a split shank replaceable type hammer head. The heads wear eight weeks or better and the shanks last for three to five sets of heads.

A number of 225-ton, 16-ft diameter fabricated steel kettles are used in the lead refinery. These are subjected to rapid and extreme temperature changes, and stress cracks develop. A method was devised which successfully welded the stress cracks—some kettles have been repaired as many as eight times.

The smelter crushing plant contains a 62-ft-high bucket elevator capable of handling 200 tph. It was very expensive to maintain and frequently caused unscheduled crushing plant shutdowns (the elevator chain broke several times, dropping everything into the elevator boot). A company survey found that the trouble was caused by careless or faulty operation and lack of scheduled maintenance. By starting a weekly maintenance and inspection schedule, by using lubricants previously employed in other equipment, and by making operators aware of feed limitations, Bunker Hill was able to double the chain life and cut maintenance by two-thirds. There have been no recent unscheduled crusher plant shutdowns.

Carey Salt Schedules for Maintenance

RONALD B. STONE

SMALL MINES AND MILLS can profit extensively with a workable preventive maintenance system. Small mines and mills may be defined as those which employ a work force of 50 men or less. Most of these units operate with a single line of production, i.e., one drill, one loader, one trammer or engine, one hoist, one crusher, etc. When one part of the production equipment breaks down, the entire plant is shut down until necessary repairs are made. Under an efficient system of preventive maintenance, production is maintained with minimum down time.

Any preventive maintenance program should have the following qualifications:

1. No extra personnel should be employed as record keepers or mechanics.

2. Expenditures in time and money on record materials and forms should be small.

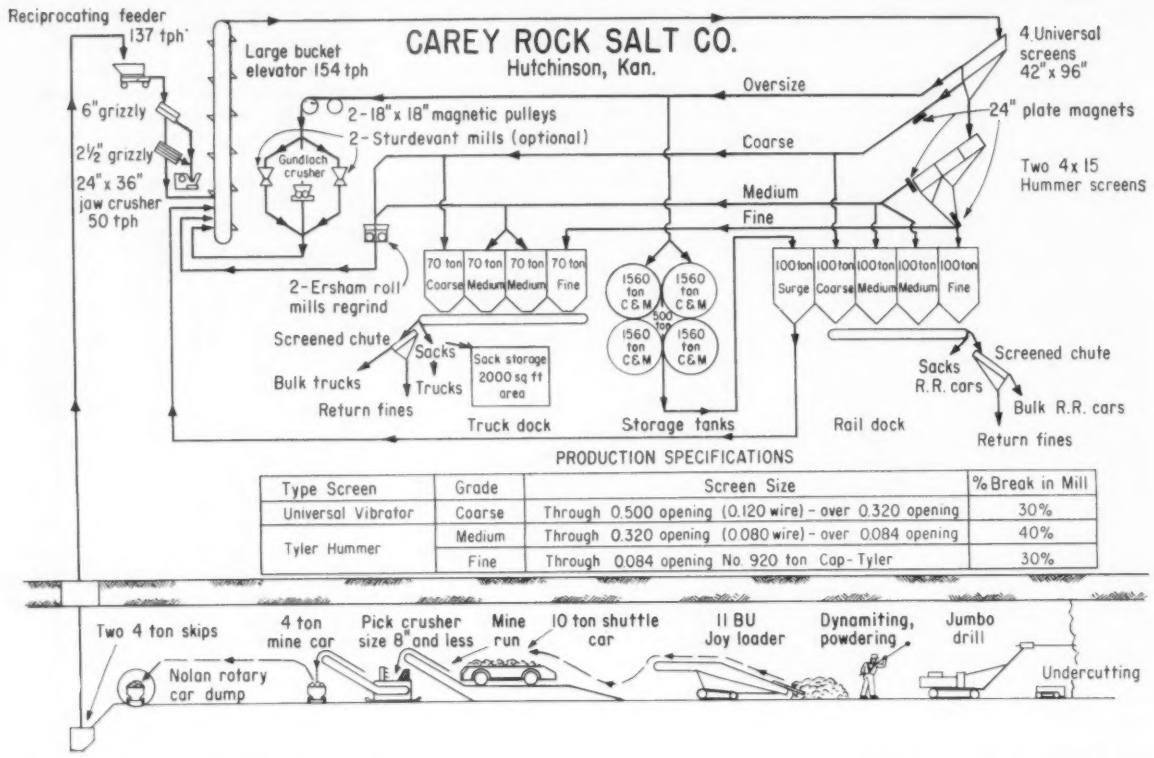
3. An adequate stock of essential parts and a small storeroom should be established. (Such spare parts as bearings, screens, etc. which are not available locally).

In January 1956, the Carey Salt Co. established a preventive maintenance program with the above standards. Although Carey Salt Co. has more than one machine of each type, all machinery is in use in production. When one is taken out of production through breakdown, operations revert to single line production. (See flowsheet.)

Operating personnel of the mine and mill totals 36, of which 13 are in the mine. Twenty-one men are in the milling and packaging department. A crew of two men handles complete maintenance of the mine and mill which are separated by a distance of approximately one mile.

There is a seasonal fluctuation in the demand for rock salt. Maximum

Mr. Stone is assistant to the chief engineer, Carey Salt Co. He held the position of maintenance superintendent at the company's mine to April 1958, when he was transferred to the present position in the general engineering office.



Type Screen	Grade	Screen Size	% Break in Mill
Universal Vibrator	Coarse	Through 0.500 opening (0.120 wire) - over 0.320 opening	30%
Tyler Hummer	Medium	Through 0.320 opening (0.080 wire) - over 0.084 opening	40%
	Fine	Through 0.084 opening No. 920 ton Cap - Tyler	30%

A RELATIVELY SIMPLE OPERATION with "a single line of production" is the author's definition of a small mine. Carey Salt employs about 50 men and depends upon all equipment in operation every day for peak production of 1,000 tpm.

daily production required is 1,000 tons per shift during the winter months. We therefore endeavor to schedule most of our preventive maintenance in the months of lowest production.

At the start of the program the essential objectives of our program were established. The most important item was an operating record or history of each major piece of equipment. This was obtained through the use of Form No. 36, Maintenance Record. (See accompanying form). The form was reproduced on standard size notebook paper. Four lines of the heading are used to identify the individual machine either by number or name. The number of the individual motor is also listed if it is an integral part of the machine. The following information is entered on each line in chronological order:

1. The date of repair.
2. Down time hours. (The amount of time the machine was out of production.)
3. New or used parts. (New or used parts used in the repair.)
4. Last overhaul. (An X is placed in this column after the date to denote the last overhaul.)
5. Nature of repair. (The individual components or parts of the machine are listed and an X is placed in the appropriate column after the date of repair, i.e., forward or reverse transmission.)
6. Remarks. (This is used to clarify the nature of the failure such as clutch plates in a transmission.)

Vertical listing of the various components is used to check the frequency of failure of the various parts and as a guide to future overhaul periods or replacement of worn parts. Form No. 36 is maintained by the maintenance superintendent and kept up to date with information from Form No. 200.

Form 200 was a natural outgrowth of Form No. 36. (See accompanying form.) It is pocket size, 4 x 6-in. and is carried and filled out by the maintenance mechanics. Mechanics are required to fill out this "Breakdown and Repair Report" at the time the repair is made. The forms are then turned in to the maintenance superintendent at the end of the shift.

In the third part of the program it was necessary to increase the efficiency of the maintenance crew so there would be sufficient time for preventive maintenance work. It was found that the maintenance crew had been doing small repair jobs which, in many instances, could have been done by the operators. To achieve the added efficiency and obtain the cooperation of the operators, we devised a third form, Form No. 201, the "Preventive Maintenance Check Sheet". (see accompanying form). This form is also pocket sized and is carried by the operators. By having the operators fill out this form, we gave them a sense of being a necessary part of the program. This enabled us to sell the program to the men. Operators filled out the form whenever they experienced difficulty with a machine. It was felt that when an operator saw his report in writing, if it was of trivial or minor importance, the operator would realize such was the case and instigate his own repairs.

The fourth step in our program was to organize for operation. Management of the mine and mill consisted of the following: the manager, the milling and packaging superintendent, the mine superintendent, and the mine engineer, who acted as maintenance superintendent.

It was the responsibility of the maintenance superintendent to keep Form No. 36 and to insure that Form

No. 200 was promptly and properly filled out by his crew. He also had authority after consultation with the other superintendents and the manager, for scheduling preventive maintenance. An additional duty of the superintendent was the establishment and operation of a spare parts storeroom.

The mine superintendent and the milling and packaging superintendent were given responsibility of checking with the operator upon receipt of Form No. 201 and determining the priority of repair. In the event of immediate repair, the maintenance superintendent was to be contacted. For routine repairs, the form was to be forwarded to the maintenance superintendent at the end of the shift. If there was a complete breakdown, the superintendents were authorized to start immediate repair.

Until a sufficient period of time has elapsed any new program will be a matter of keeping records only. As information accumulates it will become increasingly easy to schedule preventive maintenance work.

This type of program requires a minimum amount of time to keep the records. Only three to five minutes are required daily for the operator or mechanic to fill out the necessary forms. The maintenance superintendent needs only a little longer to keep his records up to date and to review them. The cost is negligible. The only extra material needed is the proper forms. This program is easily expandable into a Cardex system or any other method of keeping records which is found to be satisfactory.

A further guide which can be used is the installation of direct reading hour meters on major pieces of equipment. This, in turn, will give a closer control and record of the operation and maintenance of the machine.

The program as described is not a complete one. We have not shown a method of scheduling maintenance other than by frequent review of the records. After sufficient information has accumulated, a preventive maintenance schedule can be made up on a monthly or even yearly basis for each machine. Although we have established some overhaul periods and preventive maintenance on a few of the high maintenance machines, two years has not allowed us enough time to adequately establish a complete schedule.

The author acknowledges the wholehearted cooperation of Leo Reid, manager; C. A. Millard, mill superintendent; and E. G. Roberts, mine superintendent.

The Carey Salt Company – Hutchinson Mine
Maintenance Record

Date of Next Scheduled Overhaul –

Machine Joy Loader No. 3 | Asset No. 31-110
Serial No. 5673 | Motor

Date of Repair	Down Time Hours	New or Used Parts	Last Overhaul	F & R Trans.	Front Trans.	Ga. Th. Arm Brg.	Gath. Arm	Gath. Arm Trst.	Hyd. System	Tracks	Drag Chain		Misc.	Nature of Repair / Remarks
														New Machine – 1952 Into Service – 10/23/56
10-23-56	—	N	X	X	X						X			All New Bearings
5-23-57	1/2	N											X	Brake Clevis Bolt
10-29-57	2	N				X								Stripped Threads-New Bearing
11-21-57	1/2				X									Take Up Wear
12-23-57	1				X		X							Take Up Wear. New Gath. Arm
1-9-58	14	U						X						Rebuilt Threads-Weld Spiral S. Bolts
2-3-58	2	N							X					Hydraulic Lift Line
2-12-58	1	U					X							Installed Short Gath. Arm
5-16-58	2	N									X			3 Universal Joints
5-20-58	2	N											X	Drive Shaft & Bearings
5-22-58	1	N							X					Rebuilt Hyd. Lines with Copper
6-3-58	2	N								X				Take Up Spacing on Tracks
8-19-58	1	N											X	Swing Cable
9-26-58	2	N					X							New Swivel Arm

FORM 36 is the responsibility of the maintenance superintendent and his office.

The Carey Salt Company – Hutchinson Mine
Breakdown & Repair Report

Date _____

Machine & No. _____

Nature of breakdown _____

_____

_____

_____ No. Hours down _____

New or used parts installed _____

_____

Remarks _____

_____

Signature _____

FORM 200 is filled out by the maintenance mechanics at the time of the repair.

The Carey Salt Company – Hutchinson Mine
Preventive Maintenance Check Sheet

Date _____

Machine: _____

Nature of Trouble: _____

_____

Operator

FORM 201 is the operator's responsibility. It's use has cut minor repair calls.

IN ONE CONTINUOUS OPERATION, as the unit moves across the floor of an open pit, crude gypsum is gouged out, conveyed up to the top of the plant, screened, crushed and conveyed into windrow stockpiles or farmers' delivery trucks.

Mobile Unit Mines and Mills Gypsum

The Problem: To profitably produce agricultural gypsum at an increased rate from several small scattered surface deposits.

The Answer: A mobile mill. That's the reasoning that sent H.S. Holloway, president of H.M. Holloway Inc., Wasco, Calif., off on a tour of the West and Midwest to locate a mill he could duplicate for his eight to ten (the number varies) mines in the Lost Hills of eastern Kern County. He didn't find any one unit which fit the bill, but he got plenty of ideas. When he returned to California he had Jacobs Engineering Co. of Pasadena and Oakland design what he wanted and the Carter Machine Shop of Wasco fabricate it.

The Result: A 70-ft long, $100,000, integrated mining and milling plant on wheels, pushbutton-operated by two men, that produces 3,000 tpd of minus 1-in. gypsum and, when finished at one mine, is driven off to another under its own power.

Among the components, the Wesco crusher is unique in mining, according to Warren Carter, the robot's fabricator. Its overall operation is similar to an ice crusher. Within a rugged hopper is a revolving drum which is studded with sharp replaceable picks.

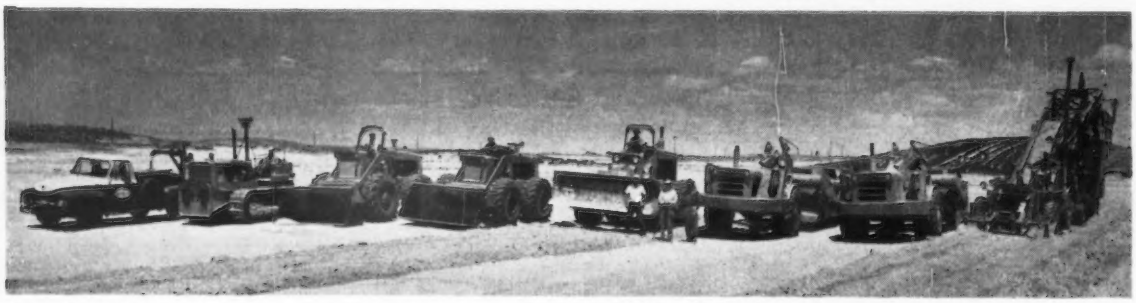
A flanged conveyor belt, rather than the usual troughed belt, is also unusual. It was selected because it "carries more weight in less space." Two-inch rubber flanges on each side of the 24-in. belt prevent material from rolling off. Flat rollers are used.

Hydraulic motors on the unit make long belt drives unnecessary, and a hydraulic system is used to swing and raise the discharge boom.

Separate panels on the gouger-loader and on the processing section control the power units—a model 371 GMC diesel on the loader and a 671 on the processor.

A dry-type cartridge filter system, supplied by Lawless Brothers, of Bakersfield, whipped a serious engine air-filter problem.

Component suppliers include: Link-Belt Co., Los Angeles, screens; Wesco Machinery Mfg. Co., San Francisco, crusher; Dura-Belting Mfg. Co., Berkeley, conveyor belts; Chain Belt Co., Los Angeles, chains, sprockets, idlers, etc.; Vickers, Inc., El Segundo, hydraulic motors, pumps, valves and controls; Standard Trailer Co., trailer; Power Transmission Equipment Co., Los Angeles, power transmission and conveyor equipment; Anderson-O'Brien Co., Los Angeles, agents for the Detroit Diesel Division of General Motors, power plant and electrical generator; Pettibone-Mulliken Corp., Chicago, Ill., loader.



OPERATIONS are on two 10-hour shifts and employ scrapers to remove overburden and move gypsum, front-end loaders to fill farmers' trucks, wheeled dozer, crawler pusher tractor and service truck. Mine sites are leased from oil interests and core-drilled to 30 ft. Product is windrowed at each mine into three grades—60, 65 and 75%—for bulk sales. Screening prevents chunks from damaging farm machines. The pioneering company claims to be the world's largest miner of farm-gypsum.

Uranium Adjusts to a Changed Market

Industry reaction to the Nov. 24, 1958 announcement by the Atomic Energy Commission, and current developments among producers has created confusion in many areas. This article is a summary of the more important influences on uranium in the U. S. today.

THE DEVELOPING URANIUM PICTURE following AEC's Nov. 28 announcement and new orebody deadline (E&MJ, December, p 19) contained a number of highlights:

1) Sale of concentrates from ore discovered between Nov. 1, 1957 and Nov. 24, 1958 could not be purchased by AEC until March 31, 1962;

2) One new mill went on stream, and two others, prior to completion of construction, started processing;

3) Despite general acceptance in the Gas Hills Wyo. area, a number of questions remained cloudy;

4) In a remarkable burst of optimism, some western uranium miners foresaw a second uranium boom following a period of no exploration because of the cutoff of Government guarantees. The optimism was based on an expected demand for domestic power plants.

The first point is made in paragraph 4-D of the AEC's Nov. 24 announcement, effecting ores discovered between Nov. 1, 1957 and Nov. 24, 1958.

It has been estimated that there are "several million" tons of ore in this category located in Wyoming's Gas Hills district; McKinley County, N.M. and in Utah's Big Indian district. Those making these discoveries must therefore wait some three years before recovering exploration costs.

The definition of an ore reserve, says AEC's Grand Junction Operations Office, is that it must be economically mineable and saleable at the $8 a lb. price for concentrates that AEC has set for the 1962-1966 program in an announcement in Federal Register of Nov. 24, 1958.

This means that depth of ore, mine economics, grade of ore and distance from mill will be controlling factors.

There is no haulage allowance in the new program, which basically consists merely of extension or modification of existing or pending mill contracts in the domestic industry.

In 1956 AEC had announced a program to buy 500 tons of U_3O_8 from any one area, each year. This program was never defined by regulation or published in the Federal Register. It is safe to assume that most uranium miners took the AEC at its word, however, on the tonnage plan affecting metal to be produced from concentrates based on ore reserves in a single mine. It is from this program that AEC withdrew in its announcement of Nov. 24, 1958.

Grand Junction Operations Office said that various district or branch offices of AEC would cooperate with miners in determining "ore reserves" in the 1957-58 program. Most districts vary and each branch has its own set of criteria. Criteria are based on formulas established early in the AEC program by the United States Geological Survey, according to Grand Junction.

AEC has as a policy accepted "indicated and inferred" ore as developed or proved ore but has rejected "potential" ore as not being a part of a reserve.

The criteria as to district and nature of deposit permit an explanation of these terms in regard to specific deposits, it is said.

In what it terms a "revised program", AEC is prepared to buy uranium concentrates in the 1962-1966 period from ore reserves already developed. But such purchases will be limited to current milling contracts; to "appropriate" extensions of current contracts to the extent that the commission determines such contracts are required; new milling contracts on the basis of the present limited expansion of milling determined necessary in the April 2, 1958 plan of the AEC; new milling contracts or contracts to take care of the ore discovered between 1957-58 dates.

There are a number of variant factors which will be taken into consideration but which have not been set forth in regulations.

At least, the program will assure those in the milling business of a program, provided they have adequate reserves. This is true of the mills, generally, in the Gas Hills, Big Indian (Utah) and McKinley County (N.M.) districts.

There are some special circumstances such as mills in the Uravan mineral belt area where price of vanadium is essential to continuation of uranium mining.

In mills far from ore reserves or areas of depleted ore, other problems will be posed for mill operators—particularly if these operators do not now possess contracts extending through the 1962-1966 period.

A peculiarity of the ore reserves of the Uravan mineral belt is that most of the small, independent miners or lease operators, who account for an estimated 65% or more of all ore supplies do not know what reserves are 60 to 90 days ahead of mining.

How they could possibly qualify for any consideration in the 1962-1966 program on basis of discovery between Nov. 1, 1957-Nov. 24, 1958 is problematical in minds of some observers.

It must be emphasized that the new plan involving concentrates purchasing based on current or extended contracts does not include any program for exploration past Nov. 24, 1958.

In fact, purchase of ores by millers from any but "certified" orebodies might ultimately turn out to be a contract violation. Certainly millers could not legally sell concentrates to AEC from such ores, without dispensation from the Government agency.

It also is apparent that AEC cannot permit "extension" of reserves as of Nov. 24, 1958. The "reserves" are reserves on that date—period. Any exceptions would have to be at specific permission of the agency.

Generally, mill operators in the west who are favorably situated have lined up in support of the new plan—basically because they are in no position to object. Independent producers see themselves generally being forced into a package deal with millers. AEC's Grand Junction Office insists, however, that provisions for custom milling in newly extended contracts between the Commission and the mills will provide for even more generous treatment of independent shippers than heretofore. But how this gets around the curtain that has been rung down on all exploration past Nov.

24, 1958, cannot be explained. In fact, AEC plainly concedes its revised plan is aimed at keeping down purchasing from domestic sources and this could not be effected if new ore was being developed through exploration.

On the other hand, no mining industry can long exist without exploration and development of new ore. So the domestic industry must now live for some time on what "fat" it has accumulated in terms of ore reserves in last several years.

Three New Mills

The 500 tpd Riverton, Wyo., mill of Fremont Minerals, Inc. has started processing its first uranium ore.

Allen D. Gray, executive vice president of Fremont Minerals, expected the plant to reach capacity during December and concentrate to be produced by the first of the year.

Construction of the mill, which commenced in April of this year, will be completed in record time, with operations under way more than a month ahead of schedule. Prime construction contractor is the Western-Knapp Engineering Co., San Francisco. Other contractors include O. W. Walvoord, Inc., of Denver, and Peter Barton of Riverton.

The Riverton mill is the first to attempt parallel acid and carbonate processing circuits. This arrangement is expected to produce lower operating costs than is normally possible in single-circuit plants, and provides for maximum flexibility of operation in the treatment of a wide range of ore types.

Additional features of the plant include a solvent extraction section for recovery of uranium valves. This phase of the process incorporates the industry's most advanced metallurgical techniques.

At full production levels, the mill will employ 75 men with a monthly payroll of about $35,000. District management for Fremont Minerals includes A. W. Runge, manager, Ore Procurement Division; G. H. Bryant, mill superintendent; and A. R. Barbee, personnel manager.

Ore will be purchased on a custom basis from producers in the Gas Hills, Copper Mountain, and Pryor Mountain areas.

Fremont Minerals, Inc. is a subsidiary of the Susquehanna Corp. of Chicago, of which J. Patrick Lannan is president. Susquehanna also owns Mines Development, Inc., which operates a 400 tpd uranium mill at Edgemont, S.D.

The new processing mill of Kermac Nuclear Fuels Corp. went on stream Nov. 28 in the Ambrosia Lake area near Grants, N.M. The new mill is the nation's largest, with a rated capacity of 3,630 tpd of ore.

The mill will process ore from six mines owned or controlled by Kermac Nuclear Fuels, as well as a limited amount of "custom" ore purchased from independent operators.

A contract with AEC provides for sales to the Commission of uranium concentrate produced by the Kermac mill through Dec. 31, 1966. Company engineers estimate that sales to the AEC during this period will exceed $300-million.

The mill, constructed at a cost of $18-million, stands on a 90-acre tract in the Ambrosia Lake uranium mining district, 22 miles northwest of Grants. Kermac's mines and mill will employ more than 800 persons when full production is reached.

The mill operates on an acid leach, solvent extraction process and produces uranium oxide.

Lakeview Mining Co.'s new $3-million reduction plant was expected to begin processing uranium ore Nov. 29, according to Dr. Garth Thornburg, president of the company.

The plant has a capacity of 210 tpd of ore and will employ about 140 men on a three-shift basis. Construction was started last May with Lakeview Mining acting as its own contractor. Engineering plans and design were developed by the Galigher Co., Salt Lake City.

Oliver Hower will be plant superintendent.

Bulk of the ore will come from Lakeview Mining's White King mine near Lakeview, but the company's five year contract with the Atomic Energy Commission also provides for processing independently produced ores. Carroll Flick is mining superintendent. James F. Poulos is general manager.

Gas Hill Confusion

Confirmation of the ore allocations in the Gas Hills, Wyo. uranium area by the full membership of the Atomic Energy Commission still left the operators with two major problems.

Federal Uranium Corp. and Union Carbide Nuclear, the two firms afforded new construction, were faced with winter-time building problems—even though it is expected these companies already had reached substantial agreement on price of concentrates.

For others, particularly Lucky Mc-Uranium, there remained important negotiations as to price.

No major construction is involved in expansion of ore run at Lucky Mc, Western Nuclear Corp. or Fremont Minerals (now completing its mill) at Gas Hills, a survey of operators discloses.

Unannounced from Washington's meeting of the full Commission on domestic uranium milling were decisions affecting expansions of milling, changed milling contracts and/or ore assignment problems affecting uranium districts in Utah, eastern (Front Range) Colorado; Texas, McKinley County, N.M. and Nevada.

(The solution of the Front Range mill competition was expected to be resolved on Grand Junction Operations Office basis soon after Jan. 1, 1959. Commission confirmation would follow this.)

Under the program of mill allocations established in August by Grand Junction Operations Office and confirmed in the AEC announcement, milling rate in the Wyoming district would be increased from 1,815 tpd to 3,585 tpd.

In this pattern, Federal Uranium Corp. Salt Lake City, would build a new 522 tpd mill utilizing counter-current, continuous, ion exchange about 1½ miles from the present Lucky Mc concentrator. Union Carbide would erect a 492 tpd mill, including an up-grader, in the same area and utilizing, say industry reports, a process similar to Federal's.

Lucky Mc would be given a contract calling for an increase in ore run from present contract of 833 tpd to 1,002 tpd. However, this firm had been running on a dispensation basis (some 1,000 tpd) during the first part of third quarter 1958.

Western Nuclear gained the largest increase, up from 444 tpd to 845 tpd. Fremont Minerals, the Susquehanna Corp. affiliate, operating solely on custom basis, was increased from 555 tpd to 745 tpd.

AEC said that settlement of the price for concentrates is a matter yet to be negotiated.

And although the announcements of the increases from offices of senators from Utah and Wyoming alleged this matter to be "routine", the operators whose contracts are being extended from March 31, 1962 to Dec. 31, 1966, had hoped the AEC would "negotiate" the matter.

It is noted that concentrates price for the new mills must have been fairly well delineated in preliminary discussions—largely because of the relationship of price to capacity.

This is not necessarily the case with existing mills.

The price is expected to be in range —give or take 50 cents of $8 per lb through 1966, date for new and existing mills.

A Re-Blooming Boom?

Western uranium men have started to re-emphasize exploration and development in connection with the nuclear power age expected to arrive between 1965-70 in the U.S.

The new twist: Multi-billion dollar investment of private and Federal agencies in reactors, etc. for commercial power development based on current prices for U_3O_8 in U.S.A.

Conclusion: Unless there is some type of program provided for exploration, the nation will be forced, 10 to 20 years hence, to duplicate the drive for new ore reserves.

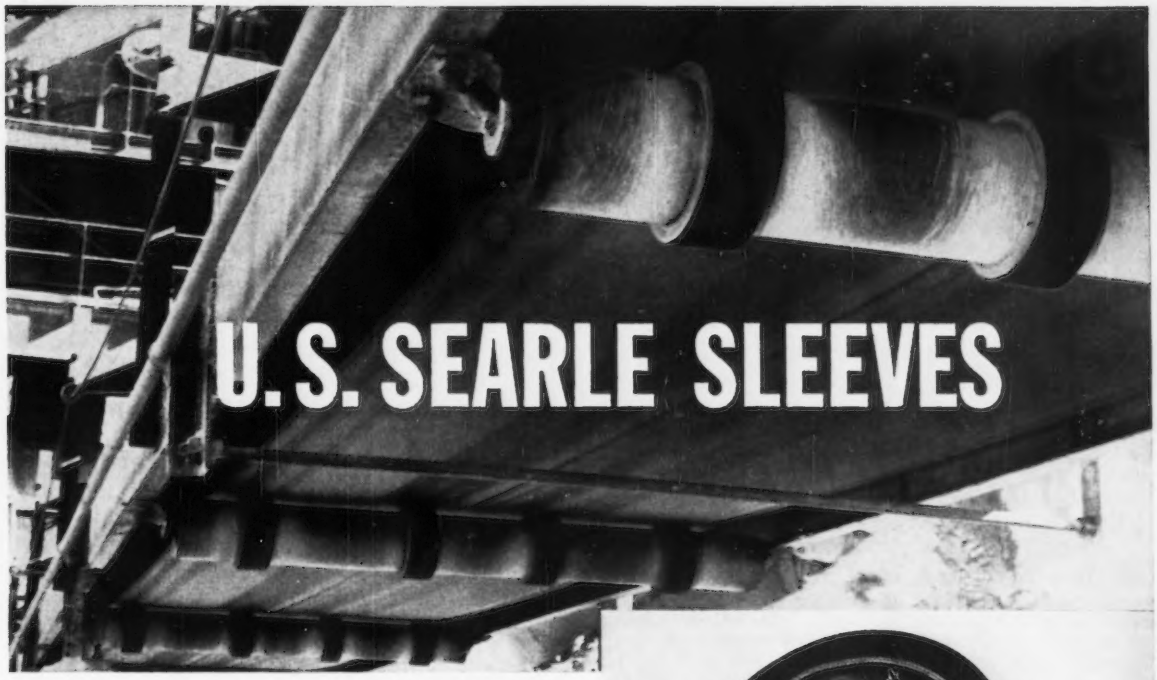
This new ore, say miners, will be infinitely more costly because of necessity of re-energizing such a domestic search with inflated dollars.

Maintenance of existing processing equipment rests on continued exploration as a guarantee for the $8 price for U_3O_8 past the present program of concentrates which will end Dec. 31, 1966.

Against the proposals of the western miner is the conviction of the Commission that current purchasing is large—plus the fact that foreign buying of U_3O_8 is in the form of a contract of the U.S. with producers over the world. It must be honored—else the U.S. would be accused of abrogating an international agreement.

SEARLE SLEEVES

The patented proven way to prolong conveyor belt life!



The patented Searle Sleeves are made of abrasion-resistant cushion rubber reinforced by heavy belt duck. Installation is fast, just slip them over the idler rolls. At impact points, cementing is recommended.

The build-up of wet muck in coal mining and fines and dust in metal mining are minimized or completely prevented on belts when idlers are equipped with U.S. Searle Sleeves. These Sleeves protect idler rolls from impact damage at transfer points. Keeping idlers clean and free from build-up eliminates constant servicing, and at the same time insures longer belt life. Belt "wandering" is eliminated and edgewear greatly reduced on both belt and idlers.

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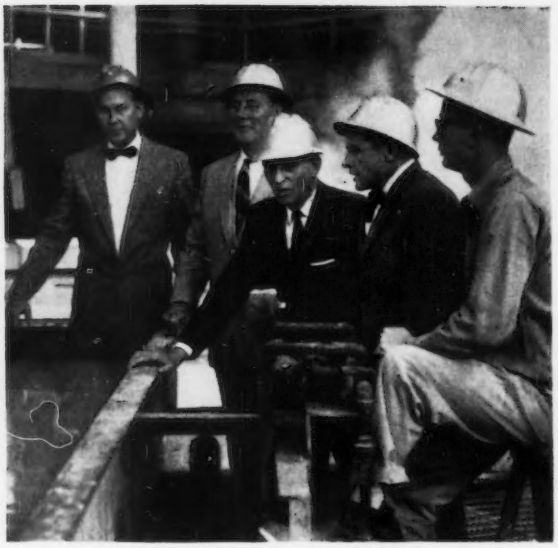
RAY MINES DIVISION is enjoying a 10% increase in copper recovery thanks to the LPF plant (right, above), which produces sponge iron and sulphuric acid from the pyrite in Ray pit ores. Smelter stack rises 600 ft against the landscape.



ON THE TOUR of the $20-million plant Howard Winn, smelter superintendent; C. D. Michaelson, Western Mining Division manager; A. P. Morris, Ray Division manager; and Frank Woodruff, general superintendent; stop at a cooling tank.

Kennecott Dedicates the Hayden Smelter

RAY MINES DIVISION of Kennecott Copper Corp. dedicated its new $20-million smelter, which, with an adjacent leach-precipitation-flotation plant, is expected to permit additional recovery from the low-grade ore from the Ray Mine.

This marks completion of a cycle of mining, milling, and smelting within facilities of the Ray Division.

Speaking at the dedication, Charles D. Michaelson, general manager of Kennecott's Western Mining Divisions, pointed up that the facility was another example of modern industry—that mines are made, not found.

Almost 90% of Arizona's copper production comes from the large low-grade mines. Copper content of the ore has been dropping steadily, and increased costs of copper producing activity require tighter, intensive processes.

In the four Kennecott Divisions of the West during 1955, the ratio of waste material to ore was approximately 1¾ tons to 1. In 1956 it had increased to almost 1.96 tons to 1, and in 1957 to 2.13 tons to 1. For the first nine months of 1958 it has averaged just below two tons of waste to one ton of ore.

Last year Kennecott's four divisions mined 58-million tons of ore—removing almost 114-million tons of waste.

Michaelson noted that the copper recovery in Arizona per ton of ore treated in the decade 1910 to 1919 was 48 lb to the ton. From 1920 to 1929 it was 35 lb; from 1930 to 1939, 32. From 1940 to 1944, 21 lb, and from 1944 to 1955 only 17 lb.

The integrated leach-precipitation-flotation facility, producing its own sponge-iron and sulphuric acid from the pyrite waste material in Ray ore, has made possible the profitable recovery of non-sulphide copper minerals in Ray ore. Before the integrated LPF system was built, the sulphuric acid and sponge-iron necessary for the process cost more than the additional copper — approximately two pounds of Ray ore—would bring on the market.

The LPF installation at Ray permits an increase of approximately 10% the amount of copper recovered from ore of the division.

Plans for expansion for the future call for boosting division productivity by 20,000 tons of copper annually. This will be done by enlarging the pit and relocating various surface facilities, and expanding capacity of the mill.

The entire program in effect at Hayden and Ray will cost approximately $40-million.

Michaelson called on Arizona to assist its own economic growth by creating an atmosphere healthy to mining. His propositions covered payrolls, purchase of supplies and services, dividends to stockholders, and tax payments.

He recommended four points to maintain a healthy business climate that would permit continuing economic and industrial growth in Arizona and the West. They are:

1. Fair and equitable treatment in general legislation and administration for all segments of Arizona's economy.

2. Equitable tax policies and restriction of cost of government to reasonable levels.

3. Fair treatment for all in legislation and administration of labor-management relations affairs.

4. Fostering an economic atmosphere which allows Arizona agriculture and industry to compete for out-of-state markets.

The new Hayden smelter contains 142,000 square ft of working space, including the smelter power plant annex.

Its major components include:

1. The concentrate filtering plant and storage areas;

2. The silica crushing plant and bins;

3. Reverberatory furnace, 120 ft long, 35 ft wide, 28 ft high; two waste heat boilers, each capable of 65,000 lb of steam per hour;

4. Two converter aisle cranes with 60-ton main hooks and 25-ton auxiliary hooks each;

5. Three converters; two anode furnaces;

6. Anode casting wheel and shipping floor;

7. The smelter power plant, with a 9,375 kw generator, plus conveyor systems, dust collecting system, and 600-ft smokestack.

The smelter required 7,243 tons of steelwork and 30,400 cubic yd of concrete.

The 1,000-tpd capacity smelter produces about 250 tons of anode copper daily.

Other speakers at the ceremony included A. P. Morris, general manager for Ray Mines Division; Frank G. Woodruff, general superintendent, reduction plant, Ray Mines Division; Joe F. Sotelo, chairman of the Arizona Development Board; and Gov. Ernest W. McFarland.

B.F.Goodrich

B.F.Goodrich tires give coal hauler 50% more service than any other make

TWIN SEAM MINING CO. of Tuscaloosa, Ala. operates 17 dump trucks to haul coal over dirt roads that are mountainous and winding. Payloads average 15 tons. Tire blowouts from impacts against rocks were a problem for Twin Seam. Then they switched to B.F.Goodrich Rock Logger tires. Result: no road delays caused by punctures or blowouts, and 50% more service than from other makes. Rock Logger tires are retreaded after 100,000 miles for an additional 50,000 or more miles!

B.F.Goodrich builds the Rock Logger with a specially compounded tread that resists rock cuts and bruises. Under the tread is the B.F.Goodrich FLEX-RITE NYLON cord body. FLEX-RITE NYLON withstands double the impact of ordinary cord materials, resists heat blowouts and flex breaks. No wonder this B.F.Goodrich cord construction outwears even extra-thick treads, can still be retreaded.

Take a tip from Louis Bosch, head mechanic at Twin Seam, who says: "Rock Logger tires give excellent traction—and can really take a beating!" See your nearby B.F.Goodrich Smileage dealer today. He's listed under Tires in the Yellow Pages of your phone book. *B.F.Goodrich Tire Co., A Division of The B.F.Goodrich Co., Akron 18, Ohio.*

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Smileage!

B.F.Goodrich *truck tires*

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WHAT'S NEW IN U. S. PATENTS

OLIVER S. NORTH

Mining

Improved drive connection for use between a drive bushing and a driven boring member, particularly for use with a Kelly bar used for boring holes in ores of exceptional hardness, such as taconite. W. M. Petrell, assigned to Reserve Mining Co. No. 2,859,939.

Method for selective fracturing of magnetic taconite ore. As applied in an open-pit mine, the overburden is stripped off and the ore subjected in situ to high frequency magnetic energy to cause volumetric changes and resultant tensile strain fracturing. The layer of broken ore is then scraped away. Alternatively, large lumps of taconite can be broken down by passing them on a belt through high frequency magnetic fields produced by loops or pancake coils. H. Latour and H. D. Wren, assigned to Armco Steel Corp. No. 2,859,952.

Metal and Mineral Processing

Design for a portable and mobile mineral separator of the flotation and centrifugal type, for separating heavy mineral particles from lighter waste materials. Bowl rotation speed may be varied as needed for treating materials of different specific gravities and viscosities. This apparatus is especially useful for prospecting heavy sands and for working small and widely scattered concentrations of mineral values. R. W. Clow and J. J. Snyder. No. 2,858,064.

In the separation of uranium from water-immiscible solvent solutions, the solution is contacted with ammonium carbonate, and the resultant uranyl carbonate recovered. F. T. Fitch and A. J. Cruikshank, assigned to U.S. AEC. No. 2,858,187.

Improved method for recovering from aluminum reduction cell linings absorbed fluorides of aluminum and sodium, which tend to render such a cell unserviceable. The lining is broken into coarse pieces and heated at subatmospheric pressure in a crucible to volatilize the contained fluorides. The resultant vapor is condensed. J. P. McGeer, V. Mirkovich and N. W. F. Phillips, assigned to Aluminium Laboratories, Ltd. No. 2,858,198.

As a means of increasing the output of an iron ore sintering machine, the mixed ground ore is not sintered to form a cake, but instead is pelletized, granulated, or agglomerated before being fed to the sintering band. Pellets should be in the 2 to 10mm size range, and should be sintered immediately after their formation. K. Meyer and H. Rausch, assigned to Metallgesellschaf A.-G. No. 2,858,204.

Apparatus and method for continuous indirect reduction of zinc oxide ores by means of second-stage carbon regeneration of the intermediate ferrosilicon reducing agent. E. Warland, assigned to Panmetals & Processes, Inc. No. 2,858,205.

Solvent extraction process for recovering uranium, thorium, and other metal values from crude industrial phosphoric acid solutions, such as those derived during processing of phosphate rock. R. H. Bailes and R. S. Long, assigned to U.S. AEC. No. 2,859,092.

Process for the separation of columbium and/or tantalum from titanium concentrates. A hydrous titanium oxide is added to a solution of said concentrates, and the pH is held at 2 to 7 to precipitate hydrous oxides of columbium and tantalum. J. R. Ruhoff, G. L. Martin, and C .O. Gerfen, assigned to Mallinckrodt Chemical Works. No. 2,859,098.

As a means of recovering tantalum values from a tantalum-columbium concentrate, a hydrous oxide of columbium is added to an aqueous solution of said concentrate, and the pH held at 2 to 6 to precipitate hydrous tantalum oxide. J. R. Ruhoff, G. L. Martin, and C. O. Gerfen, assigned to Mallinckrodt Chemical Works. No. 2,859,099.

In a method for producing iron powder of desired grain size, magnetite concentrate or other iron oxide ore is ground to the projected grain size or less, and then reduced to obtain sponge cake, which is cooled and ground. N. H. Brundin, assigned to Hoganas-Billesholms Aktiebolag. No. 2,860,044.

COPIES of U.S. patents can be purchased at 25c each from Commissioner of Patents, Washington 25, D. C.

Method of extracting silica-free alumina from raw calcium aluminates containing silica as an impurity. Process may be varied to obtain greater or lesser yields of alumina according to degree of purity required. J. C. Seailles. No. 2,859,100.

Process for treating vanadiferous iron ores to recover the vanadium and simultaneously to produce a sintered lump iron product. Ground ore is mixed with Na_2SO_4 and sintered at optimum temperature under oxidizing conditions. Resultant sinter is leached with water, and the vanadium precipitated from the leach solution. N. H. Brundin and G. E. H. Landberg, assigned to Hoganas-Billesholms Aktiebolag. No. 2,859,107.

Method for exothermic reduction of iron oxide or other metallic oxide ore. A mixture of ore and burnt lime is pelletized or otherwise agglomerated. Hydrogen is used as the reducing agent. J. O. Edström and U. O. H. Wiberg. No. 2,860,046.

Process for removing arsenic from HCl suspensions of arsenide and sulpharsenide ores, such as smaltine with chlorine gas. F. Reynaud, G. Gravey, and A. Roth, assigned to Societe d'Electro-Chimie d'Electro-Metallurgie et des Acieries Electriques d'Ugine. No. 2,860,047.

Method for recovering alkali metal values from polyhalite, langbeinite, alunite, glauberite, or other complex alkali metal sulphate ores. Ground ore is fused with silica sand, whereby metals present other than the alkali metal is changed from sulphate to silicate form. Sinter cake is ball milled, the slurry, filtered and the filtrate washed with water to recover substantially pure alkali metal sulphate. G. L. Cunningham, assigned to Horizons Inc. No. 2,860,951.

Method of roasting sulphide ores in powder form by passing them in suspension of air or gas into a heated chamber. As a means of eliminating the necessity for extremely fine grinding of the ore, the material is roasted partly in suspension and partly on a sole-plate of the furnace. E. Leroi, assigned to Societe Anonyme dite: Krebs & Cie. No. 2,860,964.

In a process for working up nickel-bearing sulphide ores containing copper, cobalt, and/or nickel, the concentrate is first partially roasted to adjust the sulphur content, and then treated with ammonia and oxygen to dissolve the non-iron metals. Iron oxide-containing residue is separated, and can then be reduced to metallic iron. L. Schlecht and G. Trageser, assigned to Badische Anilin- & Soda-Fabrik A.-G. No. 2,860,-967.

In the flotation concentration of oxide ores of heavy metals, the reagent combination used consists of a fatty acid collector having at least 12 carbon atoms or a naphthenic acid, a water-soluble salt of a heavy metal, and a hydrocarbon oil. Examples of successful use of this mixture are cited for Three Kids and other manganese ores, iron oxide ore slimes, Bolivian cassiterite, wolframite, low-grade chromite, ilmenite, and Colorado Plateau carnotite. J. R. Lord, assigned to Southwestern Engineering Co. No. 2,861,687.

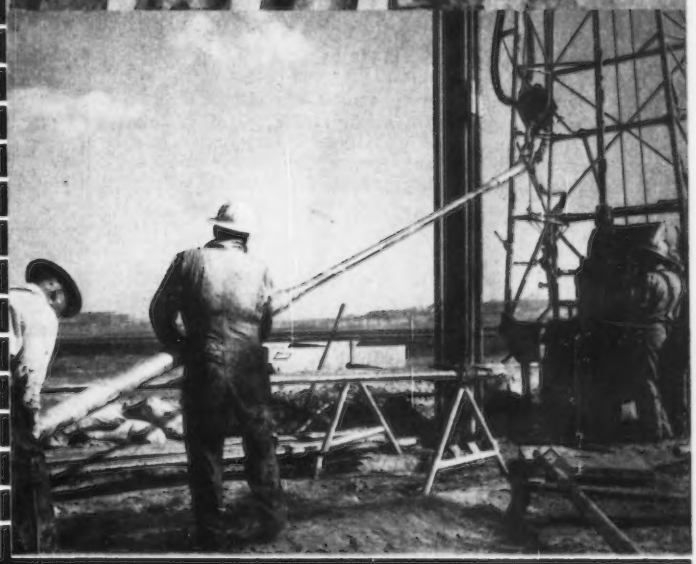
Design for a thickener for use in a wet mill operation, e. g., a mill treating heavy sand slurries from a suction dredge. This apparatus has an improved plate and baffle arrangement to cause rapid and efficient settling of solids. I. B. Humphreys. No. 2,861,692.

Using organic orthophosphate extractants in solvent extraction and leaching processing of a variety of mineral acid solutions, aqueous slurries, etc. Examples are cited to show successful use of this extractant for treating Lukachukai ore leach liquor, Slick Rock leach liquor, caustic leach residue of Florida leach zone ore, and in the direct leaching of Utex ore. R. R. Grinstead, assigned to U.S. AEC. No. 2,860,031.

Mr. North is patent consultant, Washington, D.C.

INCREASE CORE RECOVERY

IN "HARD TO CORE" FORMATIONS



Christensen adapts equipment to deliver highest percentage core recovery

Until recently the mining industry has had to put up with very poor core recovery in soft, sticky or unconsolidated formations, making accurate analysis of ore reserves extremely difficult. To increase core recovery Christensen, working closely with the operator, adapted equipment to the job. This newly adapted soft formation equipment cores ahead of the circulating fluid, protecting the core from fluid erosion. Today the geologist is receiving complete soft formation cores which enable him to fully analyze the ground below the rig for productive ore bodies. This is the result of a Christensen field consultant working in the field with the operator to adapt equipment to the job. **Whether it is soft formation or hard abrasive fractured rock, Christensen know-how is always available to help you increase core recovery and operate at "less cost per foot," regardless of operating conditions.** Call or write the Christensen field consultant nearest you today.

Every dollar invested in exploration is spent for the sole purpose of evaluating ore reserves. To properly analyze the ground below the rig, the geologist must have "good" cores. Christensen's 4½" x 3", B-3018 barrel delivers best possible cores in soft formations. For more detailed information write Christensen Diamond Products. Specify No. SF-967.

Diamonds Mean, "Less cost per foot."

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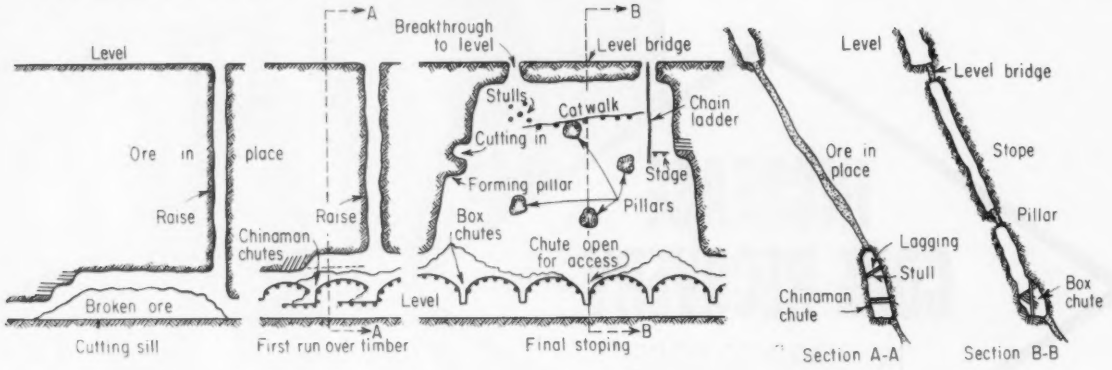
OPERATING IDEAS



Radium Hill Mines Narrow Open Stopes With Vertical Slices

THIN VEINS of uranium ore being mined at Radium Hill in South Australia are excavated with open stopes as shown in the drawing prepared by company engineers. The steeply dipping nature of the deposits requires chain ladders and catwalks for drilling and blasting. But the dip also permits using gravity chutes for loading. Both chinaman and box chutes are used on approximately 25-ft spacings. Lagging and supporting stulls between the chutes are placed to form a strong arch. Some stulls are used for roof support but, wherever possible. lean-ore areas serve as pillars.

Box Locks-up Tractor Controls

A LOCK-UP BOX made from sheet metal, placed over the starting and ignition controls of a crawler tractor owned by Colfax County, Nebraska, helped discourage unauthorized persons from attempting to start and operate the machine when left overnight on the job . . . International Harvester Co.

Tailings Build Own Dam

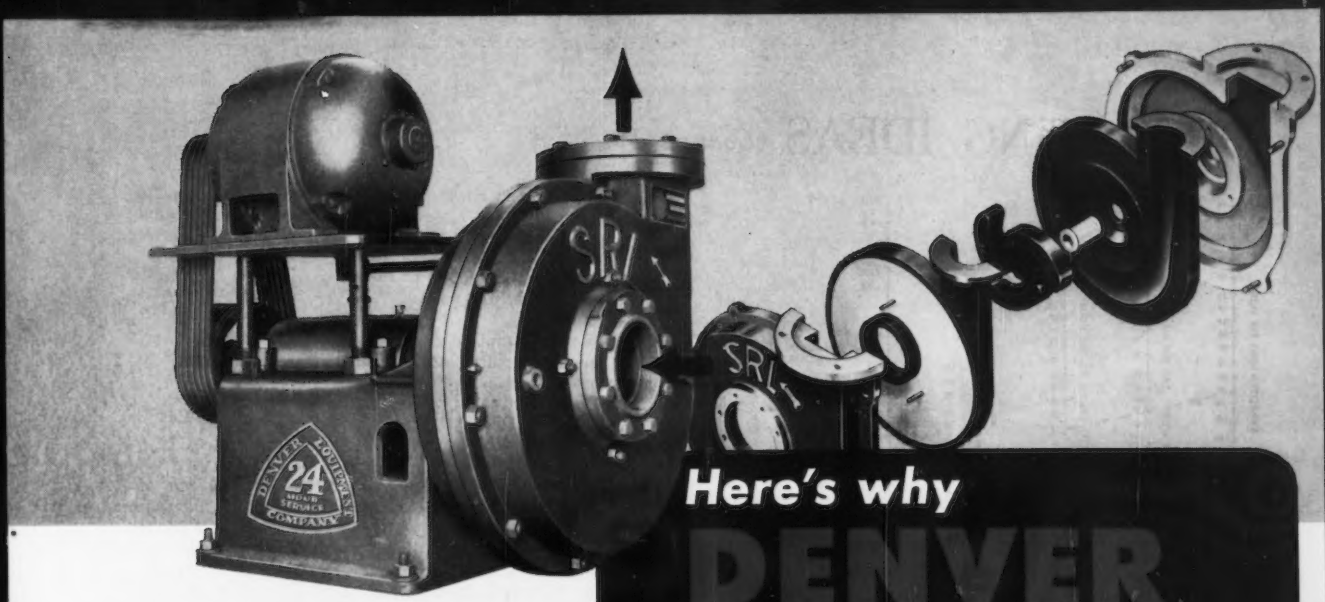
A SELF-BUILDING tailings pond retention dike is Kennecott Copper Corp.'s Utah Copper Div.'s latest cost cutting idea.

A 1,500-ft, 12-in. diameter Transite pipe (presently in the testing stage), equipped with discharge ports, is mounted on top of a corrugated metal fence running on the inside edge of a section of the 60-ft wide dike surrounding Utah Copper's 5,800 acre tailings pond.

Tailings discharged through the ports build up on the inside portion of the fence, forming the dike base. Fence and pipe will be removed once a year and the dike capped with gravel fill material to provide a stabilized roadbed and to prevent wind and water erosion.

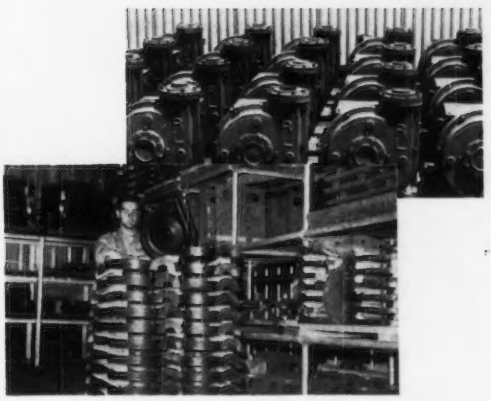
With the new set-up, however, the company will not have to mine, haul, and dump gravel to build the entire dike, and could save $180,000 annually.

The present method of dike building requires about five yd of gravel fill material per lineal foot. The elevated discharge system will reduce this to about one yd of gravel fill. If successful, the elevated system will be extended to completely circle the huge tailings pond.



Here's why DENVER SRL PUMPS

wear up to 15 times longer... Save you up to 40% in horsepower



All DENVER Pumps and parts are carried IN STOCK FOR QUICK DELIVERY. Fast replacement parts service reduces your inventory requirements.

Capacity to 5000 g.p.m.

SPECIFICATIONS AND DIMENSIONS

Pump Size and Type	Capacity 60' Head RPM	HP	*Water Av. GPM	Dimensions (In.) L	W	H	Approx. ship wt. lbs.
1½"x1"	2190	1.9	40	24	17½	23	525
2" x2"	1500	4.9	160	25½	17½	26⅜	575
3" x3"	1400	6.8	260	31¼	19¾	31½	850
5" x5"	1060	17.4	800	37¾	26¼	36½	1550
6" x6"	1170	36.3	1600	45¼	28½	46½	2300
3" x3"—C	1450	8.2	260	37½	21½	33¾	1240
5" x4"—C	1035	12.6	700	40¼	27	37⅝	1600
8" x6"—C	920	39.8	1600	63	36½	49¼	4375
10" x8"—C	820	74.0	3300	68¾	43	57	5100
12" x10"—C	615	115.0	5000	71¾	45	63	5900

*Based on water. Multiply horsepower by specific gravity of pulp to obtain actual brake horsepower.

DENVER SRL Pumps are world-renowned for handling tough sand and slurry pumping jobs easily, efficiently and at low cost. These design features tell why...

- **LONG SERVICE.** Molded rubber runners are pressure-molded to close tolerances, over steel skeleton. This gives necessary rigidity and provides precision fit of parts that results in high pumping efficiency. Casings are rubber bonded to steel backing plate. Rubber covered parts last up to 15 times longer than the best hard iron or alloy steel. Result is fewer shutdowns...lower maintenance.
- **LOW HORSEPOWER.** Accuracy of pump design and hydraulic efficiency produce up to 40% savings in horsepower over equivalent all metal pumps.
- **SIMPLE CONSTRUCTION.** Has only few parts, rugged design. Available in either sealing water type or with mechanical shaft seals, open or closed runner. Alloy metal runners also available.
- **LOW PRICE.** Quantity production means DENVER SRL Pumps are now priced low—so low that no operator can afford any pump service less than that of DENVER SRL Pumps. Parts cost less, too, and last longer, for even greater economy.

We invite you to learn how DENVER SRL Pumps can save money for you. Write for recommendation and prices.

"The firm that makes its friends happier, healthier and wealthier"

DECO EQUIPMENT — DENVER EQUIPMENT 24 HOUR SERVICE COMPANY

Complete Mill Equipment

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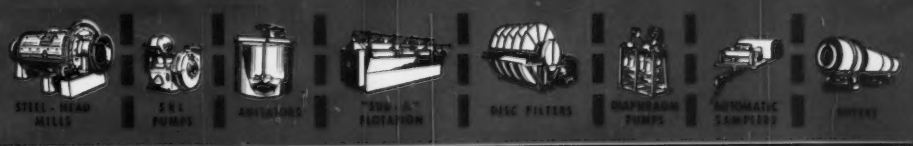
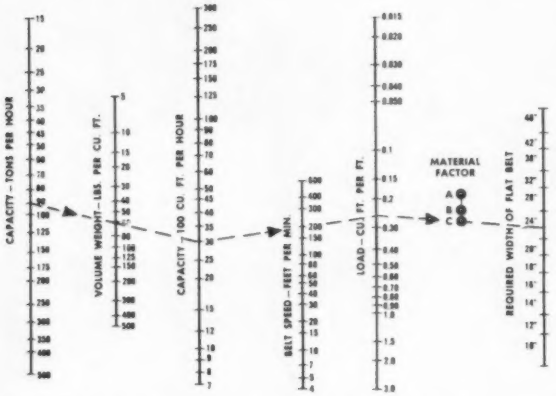


OPERATING IDEAS (*Continued*)


CAPACITY – TONS PER HOUR
VOLUME WEIGHT – LBS. PER CU. FT.
CAPACITY – 100 CU. FT. PER HOUR
BELT SPEED – FEET PER MIN.
LOAD – CU. FT. PER FT.
MATERIAL FACTOR
A
B
C
REQUIRED WIDTH OF FLAT BELT

Graph Pinpoints Belt Width

A HANDY CHART for computing the proper conveyor belt width for handling bulk materials has been prepared by the Steel Belt Conveyor Div., Sandvik Steel, Inc., Fair Lawn, N.J.

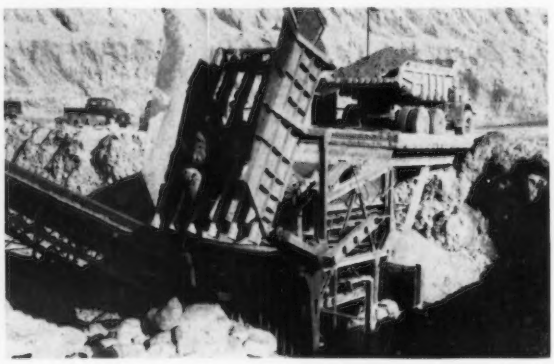
It is only necessary to know the tonnage of the material to be moved per hour, its loose density in lb per cubic ft, conveyor speed (fpm), and a material factor which Sandvik breaks down in the following manner:

	Factor
Materials with sharp edges	
with or without dry fines	"B"
with moist fines	"C"
Materials with round edges	
with or without dry fines	"A"
with moist fines	"C"
Powdered materials	
dry	"A"
moist	"C"
Plastic materials	"C"

To find the belt width recommended to carry 90 tph of material weighing 60 lb per cubic ft at a speed of 200 fpm and having a material factor of "C", locate 90 on the "tons per hour" scale and project a line through 60 on the adjacent "lb per cubic ft" scale until it intercepts the "cubic ft per hour" scale. A line is then drawn from this point through 200 on the "ft per minute" scale and extended to the "cubic ft per ft" scale. From here the line is extended through the material factor designation "C", and the interception of this line with the final width scale indicates that a 24-in. belt should be specified.

Grizzly Dumps Boulders Away

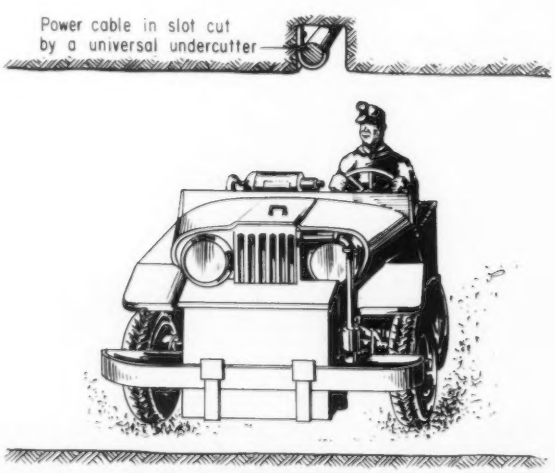
A HINGED GRIZZLY has solved the boulder-choking problem at Round Mountain Gold Dredging Corp., Round Mountain, Nevada.



Euclids (15-yd capacity) dump gold-bearing gravel onto 22-in. bar-spaced grizzly deck which covers a steel belt-loading hopper equipped with a 60-in. reciprocating plate feeder. When raised into dump position by hydraulic rams, the grizzly neatly casts off boulders without hand or crane work. See page 112 for a coverage of the entire operation.

Roof Slot Cuts Electric Hazard

LOW-HANGING POWER CABLES and wires have always been a major hazard in underground stoping areas. The mining department of International Minerals & Chemical Corp., Carlsbad, N.M., solved the problem by placing all cables and wires in slots cut into the chamber roof by a universal undercutter . . . from the company publication *Internationalite*.



No. 11 in a series

Right off the Wire

Before the first nuclear-powered merchant vessel is launched, a new reactor system which has been designed is expected to reduce the cost of a comparable installation by forty per cent.

&

After leaving a new electric shaver plugged into an outlet overnight it can be used for a week without recharging.

&

A radio operator's vest, with pockets for dry cells, can be worn under outer garments in arctic cold. The batteries, when kept warm by body heat, are said to last ten times longer.

&

Automobile batteries are now made with cells which can be removed and replaced in a few minutes.

&

A new electronic surveying technique, now in use in highway layout work, enables engineers to establish numerous ground control points and measure distances in a matter of minutes. Maximum possible error is only 11 inches in 40 miles.

&

Copper strip is being made from powdered metal. The process can also be used for other metals which can be combined in no other way.

&

A portable building for use in the arctic has hollow walls of nylon fabric. When the walls are inflated the building stands erect.

&

A research program has begun for the study of new semiconductors for use in transistors. The materials are indium phosphate, gallium arsenide, aluminum antimonide.

&

An insulated guard rail for the end of the boom is made to protect a crane operator in case of contact with a power line.

More and better rayon is the object of a study of cellulose growth in living trees. Two-year-old pines are injected with radioactive carbon and are later cut down for examination.

&

A new plastic adhesive used in aircraft construction is semi-elastic and stronger than the metals it joins.

&

A new titanium alloy is made into sheets that will withstand air pressures of over 100 tons per square inch.

&

The "world's loudest noise" can be produced by a new compressed air loud speaker that is capable of projecting the human voice for ten miles.

&

Further information on these news items and on Simplex cable is available from any Simplex office. Please be specific in your requests.

&

Twelve pneumatic tires, each supporting a load of 20,000 pounds, enable a new lift to pick up and move concrete pipe sections at five miles per hour.

&

The Post Office Department has awarded a contract for the development of a mechanical letter-sorting machine.

&

Aerodynamic shapes designed to travel at over 8,000 miles per hour can be tested in a new wind tunnel.

&

Layers of steel, bronze and a mixture of lead and plastic compose a new dry bearing material that requires no lubrication.

&

Coils of aluminum, plastic or steel, up to 82″ O.D., can now be spiral wrapped by machine.

A new method of producing electricity uses a fuel cell that converts hydrogen and oxygen into direct current by means of a catalyst.

&

A new recording instrument measures heat absorption in any area and is used for allocating air conditioning or heating charges to tenants.

&

Quartz tubing is being made so small that fifty feet contain only one drop of water.

&

A new heat resistant paper is made of ceramic fibers.

Simplex Goes To Sea

The 36,000-foot "sea section" of the Simplex submarine communication cable, for use between Cape Neddick, Maine, and Boone Island Light, was loaded in August at Boston.

The cable came off a giant reel (dia. of head 126 inches) and was carried over a capstan to the 126-foot barge.

The cable is described as "4-conductor, No. 9 AWG stranded, ANHYDREX insulated, armored submarine communication cable."

The reel and its load of more than six miles of cable weighed 68 tons.

SIMPLEX WIRE & CABLE CO.
Cambridge, Massachusetts and
Newington, New Hampshire

Simplex

Highest quality cables for: Mining
Power & Lighting • Construction
Transportation • Communications
Signalling

THREE LINES of action for the mining industry were outlined to Northwest Mining Association members by Royce A. Hardy.

MISS SPOKANE, wearing her official costume, welcomed the visitors. Wallace G. Woolf, Bunker Hill, sits to her right.

NWMA Exhibits "Restrained Optimism"

THE MAINTENANCE of a healthy and vigorous mining industry in the United States will require realistic policies and close cooperation between industry and government, Assistant Secretary of Interior Royce A. Hardy told the 64th annual convention of the Northwest Mining association in Spokane.

The convention, at the Davenport Hotel Dec. 5 and 6, drew 769 registrations, including 30 students and 134 women. There was a feeling of "restrained optimism" among a number of the mining industry representatives on the outlook for the industry in the next few years. Some felt that the recent import quota program was a step in the right direction but indicated that a tariff program would provide more help.

Hardy outlined three lines of action which he said would contribute to the objective of transforming the nation's mineral resources into economic strength and permanent benefits.

"In the first place," he said, "we must do much more exploration than we have been doing—not simply to extend known deposits but to search for new, important, now unknown deposits of commercial grade.

"In the second place, we must accelerate research if we are to obtain a better understanding of how mineralization occurs in nature, and if we are to learn the secrets surrounding the genesis of ore deposits.

"Finally, we must find ways in consultation with other nations to achieve a greater degree of stability in our markets."

Hardy said that the salvation of the domestic minerals industry in the years ahead will depend in large part upon how effectively it opens up new exploration horizons. He added that conservative estimates indicate that better than 90% of the total gold, silver, copper, lead and zinc production in this country thus far has come from a mere 1,000 square miles of territory.

Hardy said that the new Interior Department program, recently authorized by Congress, would get underway soon to provide limited financial assistance to private exploration effort. The program will be administered along the lines followed by the Defense Minerals Exploration Administration.

Reviewing the recent international conference at Geneva, Hardy indicated that the sessions laid the groundwork for a greater understanding of the lead and zinc problem. He said that the Geneva conference did convince most of the representatives that should production outside the United States continue at current levels through 1959, it would be substantially in excess of anticipated consumption.

"I do not wish however to leave with you the implication that the Administration is abandoning other courses of action when justified," Hardy said, pointing to the President's recent action on import quotas for lead and zinc.

Charles P. Mead, assistant director of the U.S. Bureau of Land Management, told the convention that in the past two years, more public land has been restored than has been withdrawn. He cited this as evidence that the land withdrawal picture is in a leveling out process.

1959'S OFFICERS are Frank N. Marr, treasurer; D. E. Watson, secretary; J. B. Haffner, vice president; E. K. Barnes, president; and Ross D. Leisk, vice president.

According to Mead, the bureau has before it requests for the withdrawal (in various categories) of about 22-million acres of land, and requests for the restoration to vacant public land status of about 29.5-million acres.

A delegate to the recent Geneva conference on lead and zinc, Harold E. Lee, vice president of research and development for Bunker Hill Co., indicated that the talks were helpful in developing a basic understanding of the problem.

"Although the immediate accomplishments of the Geneva lead and zinc conference may appear somewhat vague and limited, in general and under prevailing circumstances, the outcome was satisfactory to the U.S. delegation and consistent with the U.S. position as outlined in their pre-conference reply to the UN secretary-general.

Lee said that considerable unofficial comment was noted to the effect that the U.S. quota action comprised the first step in correcting the world lead-zinc market situation.

Dean E. F. Cook of the University of Idaho College of Mines said that the problems facing Idaho's mineral industry arise from four factors. He cited these as the continued competition from foreign producers; the uncertainty of technical developments and the rate of market expansion in such strategic materials as columbium, tantalum, cobalt, thorium, titanium, beryllium and zirconium; the need to upgrade and process low-value, bulky mineral commodities like phosphate and clay, in order to produce marketable products and to overcome a somewhat unfavorable market location; and the unpredictability of government actions affecting the industry.

"These problems," he said, "can be met by research, education, time and hard work."

Cook said that time is on the side of the U.S. mining industry, pointing out that in a shorter time than it took for America's own bonanza deposits of 100 years ago to disappear, the high-grade foreign metal deposits we are now relying on will be depleted. Then he added, all nations will be in competition for increasingly scarce minerals on the basis of know-how instead of the basis of the relative richness of their deposits, as they now are.

H. Dewayne Kreager, director of the Washington State Department of Commerce and Economic Development, reviewed the report and legislative recommendations prepared by the department's industrial raw materials advisory committee.

The report recommended that the state legislature appropriate $500,000 for the 1959-60 biennium for collection of mineral resource data, geological mapping and for research and field work on clay, lime rock and iron ore in the state.

Iron ore research and field work totaling $105,000 were recommended by the report. Some $65,000 of it would be for work in the Buckhorn district of Ferry County in northeastern Washington. The work would include detailed geological mapping and a geophysical survey of the three townships surrounding the Buckhorn deposits. It also recommended studies of market factors, evaluation of known methods of reduction of ore for feasibility of application in the state of Washington and studies to determine the amenability of Washington ore.

COFFEE HOUR HOSTESS Mrs. Carlos Milner, Jr. (center) serves Mrs. John Edgar (left) co-chairman of the ladies program, and Mrs. R. J. Hundhausen, chairman.

He indicated that several firms have shown an interest in the potential of developing an iron industry in the state. The department's advisory committee report cited the advantages of electric furnace smelting in a region where low-cost power is available and added that pig iron could be produced in the state to sell at about $55 a ton.

Dr. John Convey, director of mines for the Department of Mines and Technical Surveys, Ottawa, headed the list of Canadian speakers at the convention. Convey outlined the possibility of using nuclear explosions to tap the huge oil deposits in underground tar sands of Alberta (*E&MJ*, December 1958, p 19). He said that most of the 17,000 square miles of territory with underground tar sands could not be tapped by conventional mining methods. According to Convey, studies of data from the U.S. Atomic Energy Commission points to the possibility that the heat and pressure from such a blast could aid the recovery of oil. He said the proposal is being studied by U. S. and Canadian scientists.

G. H. Finland, manager of the Alberta and Northwest Chamber of Mines, told a Canadian session of the convention that the mineral production of the northwestern part of Canada, now valued at $200-million a year, is expected to increase to more than $1-billion by 1980.

Phil R. Holdsworth, Alaska commissioner of mines, outlined the task the new state is facing in the selection of 102.5-million acres of land currently held by the federal government. The new state has 25 years to select the land and Holdsworth said that the state will seek land which will provide a good tax base.

One resolution adopted by the convention called for a "realistic" national minerals program that should include the "peril point" principle. It noted that the recently inaugurated quota program has produced beneficial results, but it added that the most equitable solution for lead, zinc and copper stabilization would be the "peril point" program.

Opposition to Senate Bill 4028, the so-called "wilderness bill," was voiced in another resolution. It pointed out that the proposed bill would set aside vast areas in the west for the sole purpose of keeping land in a wilderness state. Within such areas mining exploration work would not be permitted, it was noted. The resolution said that the bill would nullify the principle of multiple use of the public domain and its passage would not be in the public interest. It was cited as a direct contradiction to the announced policy of the Interior Department, which the resolution said recognizes the pressing need for greatly expanded mineral exploration and development.

Four new trustees were chosen: Drury Pifer, director of the University of Washington School of Mineral Engineering; Stanley W. McDougall, manager of Kellogg operations for Bunker Hill; Wray D. Farmin, a director of Pend Oreille Mines and Metals Co. and of Day Mines, Inc.; and J. J. Crowhurst, manager of Dawn Mining Co.'s mill.

The association also took a stand on two river development proposals. One resolution stated the group's opposition to the proposed Columbia River Development corporation bill that would set up a federal corporation to take over the financing, development and operation of power and water resource projects in a four state area of the Pacific Northwest.

Another resolution restated the continuing opposition of the association to a dam at the Boundary site on the Pend Oreille river in northeastern Washington state near the Canadian border.

PORTABLE steel gravel storage hopper features a hinged grizzly and a portable crushing plant. Belt conveyor leads to stockpile, which is reclaimed for travel to the wash plant.

WASHING PLANT handles 10,000 yd per day through revolving screen, jigs, tables and classifier. Dorr traction thickener in the foreground is 250-ft. Tailings are at right.

Round Mountain Gets Gold Production Underway

PRODUCTION of gold-bearing gravel at the property of Round Mountain Gold Dredging Corp. at Round Mountain, Nevada, is rapidly approaching the 10,000 yd per day mark. The large placer deposit under lease from Nevada Porphyry Gold Mines under a 15-year agreement was reactivated in July 1957 after a 5-year shutdown. To get the property into production required removal of some 2-million cubic yd of overburden and rebuilding of the large washing plant used during previous operations. Both stripping of overburden and mining of gold-bearing gravel is done on a fee basis by Morrison-Knudsen Co. Inc. Actual stripping operations were started by the contractor in July 1957, and those given over to gravel mining early in May 1958. Work on rebuilding the washing plant was started in August 1957. Since May 1958 mine and plant operations have been continuous on a 7-day week basis.

The main placer deposit currently under exploitation is on the south and west slopes of Round Mountain. It is of the residual type, none of the gold having traveled more than several hundred feet from its source. Gravel depths vary from a few feet to more than 200 ft. Thickness of overburden is from 40 to 50 ft and that of the mineable portion of the gravel face from 30 to 100 ft. About 20% of the gravel consists of coarse angular boulders of rhyolite, the remaining 80% being sand and gravel, and the bed is slightly stratified. The gravel is bonded by a limey deposit into medium hard conglomerate, particularly near bedrock. Gold is disseminated throughout the gravel, with enrichments near bedrock, and the gold particles are angular and show no evidence of having been transported. Gravel mined during previous placer operations averaged $1.00 per yd, and the gold recovered was 636 fine, being alloyed with silver. Bedrock is a rhyolite porphyry, uneven in many places.

The pit from which gold-bearing gravel currently is being mined by open pit methods measures roughly 2000x600 ft. A second pit will be developed later. Overburden is stripped down on 5-ft benches, following the contour of the ore below until economic face for the production shovel is reached. Ore benches are carried at heights varying from 15 to 25 ft. No blasting is required. Production is obtained from three active benches, the 6275, 6260, and 6250. Shovel equipment used in the pit includes a 7½-yd B-E 140-B electric, and a 2½-yd B-E 54-B diesel unit. The fleet of trucks employed is made up of 15-yd Euclids for ore haulage and 20-yd Euclids for overburden. Haulage distances do not exceed 2,000 ft at the present time.

Transportation of ore from the portable steel hopper which receives trucked material from the ore benches to the portable crushing plant and thence to the stockpile ahead of the washing plant is via a long belt conveyor system made up of a 60-in. incline section installed between the storage hopper and crushing plant and 42-in. sections thereafter. The steel hopper is equipped with a 60-in. reciprocating plate feeder and a grizzly, spaced 22 in., which is hinged and actuated by hydraulic rams to permit automatic dumping of oversize boulders. (See Operating Ideas, p 108.) The crushing plant houses a 36x42-in. jaw crusher set to give a minus 10-in. product. The discharge end of the train of 42-in. belt conveyors is supended from a vertical steel tower and can be adjusted to meet the height of the stockpile.

The stockpile proper rests on a long concrete tunnel. Stored pay gravel is drawn through three steel hoppers with air jets onto a belt feeder assembly discharging in turn onto a 42-in. incline belt conveyor leading to the 9x50-ft revolving screen on the top floor of the washing plant.

The building housing the gravel treatment equipment is an all-steel structure covered with corrugated galvanized sheets. In addition to the revolving screen mentioned, the plant contains equipment for coarse and fine jigging; screening and dewatering units; riffled gold tables; hydro separator; regrind unit consisting of a ball mill with amalgamator on discharge end and classifier to handle hutch products from cleaner jigs; high pressure and low pressure pumps to supply plant water; and others. Washing operations resemble closely those carried out on modern floating dredges. Plant fines are treated in a 250-ft traction thickener. Tailings go via twin 36-in. boom conveyors or stackers to the waste piles. The conveyors are built in sections and are lengthened whenever desired. The discharge end of the stacker system consists of a short section of 36-in. conveyor, hopper, and swing stacker.

The primary water supply is obtained from water rights on Jett Creek via an 8-mile 14-in. pipe line and pumping plant and two wells, "A" and "B," 4 and 3 miles distant from the washing plant. Both pump installations are connected to the Jett Creek pipe line. Power is furnished by the Sierra Pacific Power Co. via a 66,000-v power line running from Tonopah to Round Mountain.

J. H. Ashley, general manager, Round Mountain Gold Dredging Corp., directs operations for the company. Burton Shultis is superintendent for Morrison-Knudsen Co.

Second Magnesium Plant

A 6,000-TON capacity magnesium plant is under construction at Selma, Ala. by Alabama Metallurgical Corp. The new facility will cost approximately $3.5-million, with production due in September 1959. The firm is 70% owned by Calumet & Hecla.

This great performance story began more than two years ago— and it's getting better all the time!

More than 50 Allis-Chalmers HD-21's are handling Toquepala's toughest jobs for Utah Construction Co. and Morrison-Knudsen Co., Inc.

Working up to 14,000 feet high in the Peruvian Andes, to develop a large mining project for the Southern Peru Copper Corporation, these tractors have been constructing roads . . . building railroads . . . preparing sites for entire new towns.

They've faced some of the toughest conditions in the world . . . rock, sand, dust, cold and high altitude all rolled into one. After two years of round-the-clock operation, these machines have piled up an outstanding performance and on-the-job record.

The Toquepala story is another good reason why you should have all the facts on the new HD-21. Across America, as in the Andes, leading construction men are discovering that the HD-21 is the long-life, big-production crawler tractor they've been looking for. See your Allis-Chalmers construction machinery dealer. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

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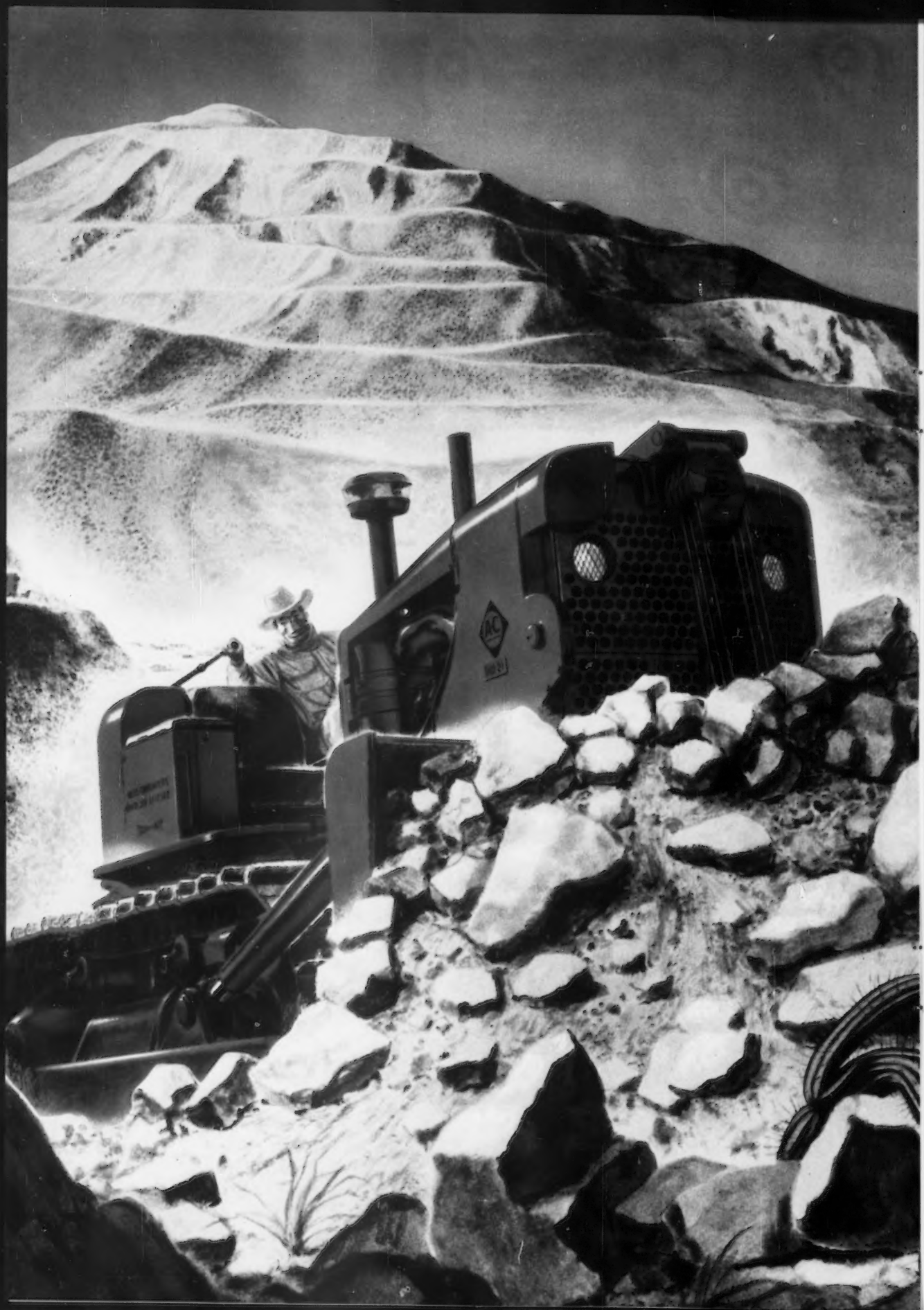
ALLIS-CHALMERS

...power for a growing world

CRAWLER TRACTORS • MOTOR GRADERS • MOTOR SCRAPERS • TRACTOR SHOVELS
PULL-TYPE SCRAPERS • MOTOR WAGONS • UTILITY TRACTORS • POWER UNITS



Working on New Frontiers high in the Peruvian Andes

Mining specialists . . . men of construction . . . and a great fleet of giant Allis-Chalmers crawler tractors are changing a remote, mountain-top desert into a modern mining center.

Toquepala (*pronounced Toe-kay-páh-la*) is its name—a wilderness hidden deep in the ancient land of the Inca Indians, so bleak and devoid of rain it's truly a mountain-top desert. There, 11,500 feet above sea level, one of the biggest mining projects in history is now under way.

Among the first machines moved ashore at the start of this venture were big Allis-Chalmers tractor-bulldozers, and today they're part of the team that is breaking through the barriers to Toquepala. To span the 100 miles from the mine to the nearest seaport, these giant tractors are pushing aside sand and rock to help build a network of roads and a railroad . . . and they're biting into mountainous terrain to level a site for a new town of 10,000 people.

Thus, the might of modern construction machinery is helping to unlock the treasures of Toquepala, considered inaccessible just a few years ago. And when the ore is ready for processing, 14 huge Allis-Chalmers mills will start grinding up this 400-million-ton mountain of copper ore at the rate of 30,000 tons a day . . . free the valuable mineral from the waste and prepare it for concentration, smelting and refining. Then, Toquepala will be one of the world's great copper mining centers, and long-range needs for this vital metal will be supplemented by a new source of supply.

From trail blazing to processing, this mammoth project typifies Allis-Chalmers service to the mining industry—through an unusually wide range of construction, power and processing equipment. It also typifies Engineering in Action . . . bringing better living to more people wherever it goes. ALLIS-CHALMERS, GENERAL OFFICES, MILWAUKEE 1, WIS.

Toquepala is a project of the Southern Peru Copper Corporation, which is stripping more than 120 million tons of overburden to reach the actual ore deposit at the mine. Major construction work for the roads, railroad and town site is being handled by two famous American contractors, Utah Construction Company and Morrison-Knudsen Company, Inc.

move ahead with

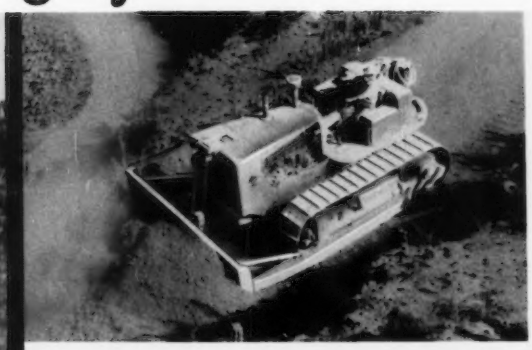
ALLIS-CHALMERS

...power for a growing world

At sea level . . . or 14,000 feet up

Allis-Chalmers HD-21's are the tractors for your tough jobs

Big Allis-Chalmers tractor-dozers cut the rocky, mountain country to size to develop a town site.



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THIS MONTH IN MINING *(Continued)*

Quebec Cartier Aims For 1961

A DELIVERY DATE of "end of 1960 or early '61" is being placed on the major productive components of Quebec Cartier Mining Co., a subsidiary of U.S. Steel. Lloyd J. Severson, president of Quebec Cartier, roughed out the ambitious iron project's history and tentative time-table last month before a meeting of the Montreal Branch of the Canadian Institute of Mining and Metallurgy.

Severson (above) said U.S. Steel started its search for iron in Canada in 1901 with the founding of the Cartier Mining Co., an Ontario corporation. The Canadian company's activities were revived 50 years later—but this time the quest was for high-grade, direct-shipping iron ore in Quebec.

The Quebec explorations uncovered little high-grade ore. But, Cartier geologists stumbled on more than they'd bargained for in low-grade ore: easy-working specular hematite containing 30 to 35% iron in the Mount Wright-Mount Reed area.

To develop this iron treasure, Mr. Severson explained, a new Quebec corporation was formed in February 1957 called Quebec Cartier Mining Co. Early in 1958, bills were presented to the Quebec legislature to incorporate Cartier Railway Co. and Hart Jaune Power Co. The former will build a 193-mile railroad between Port Cartier and Jeannine Lake. The latter will construct a 60,000 hp hydroelectric power plant on the Hart-Jaune River. With these essential rights obtained from the Quebec government, Quebec Cartier has now moved swiftly ahead on several fronts:

Work has started on docks, loading facilities and a new municipality known as Port Cartier, near Shelter Bay, about 300 miles below Quebec on the St. Lawrence. A town of about 1,500 (including 300 Quebec Cartier employees) is envisaged. Port facilities are expected to be ready before the end of 1960.

The 193-mile class "A" railway now under construction calls for the highest-quality roadbed, permitting flow of iron concentrate to Port Cartier during 12 months of the year. It's scheduled for completion at the end of 1960.

Pouring of the foundations has started on the concentrator at Lac Jeannine. Capable of producing 8-million tpy of a 66% iron concentrate, the plant—to be among the world's largest—should be ready by November 1960. The process involves a relatively simple mechanical treatment of the ore.

At a point known as Fifty Foot Falls, where the Hart-Jaune River actually drops about 500 ft. (approximately 15 miles south of Lac Jeannine) 60,000 hp is being developed. This hydroelectric energy will operate the concentrator, electric shovels at the mine, and furnish all electricity required by the mining town.

At Lac Barbel, a mining town is being erected with a predicted population of from 4,000 to 5,000, including from 1,200 to 1,500 employees of Quebec Cartier. To satisfy the requirements of the concentrator, it will be necessary to manipulate 20-million tons of iron ore every year. Quebec Cartier will start developing the mine in earnest next year.

Mr. Severson also showed the CIMM a 27-minute sound and color film entitled, "Exploration—The Search for Iron Ore in Northern Quebec," depicting Quebec Cartier's intensive study and staking of the Mount Wright-Mount Reed region, an area 70 miles long by 20 miles wide. The early airborne magnetometer surveys, followed by a heavy diamond drilling program leading to the ultimate development decision, are highlighted in the film.

ANALOG COMPUTER attracts attention of participants during "coffee-break" in lab.

Blasting Research Is Missouri Theme

BLASTING WAS HIT HARD at Missouri School of Mines' Fourth Annual Symposium on Mining Research in Rolla, Nov. 13 through 15. The conference, which was also sponsored by the U.S. Bureau of Mines, singled out ammonium nitrate for special attention—relating performance to composition and describing a mix for wet work. In addition, it tackled aspects of a more general nature—testing explosive performance, calculating characteristics (including the use of a computer), blast effects in air and rock, and descriptions of some large blasts using both conventional and nuclear explosives.

The overflow attendance required an auditorium larger than the one originally planned. And, although a number of the papers were somewhat "long-haired", the participants showed keen interest in all the proceedings. Decided differences of view on AN performance sparked a spirit of discussion that complemented the other papers as well. The meeting was attended by representatives of coal, metal and industrial mineral operators, and by technical personnel from industry, Government, education and explosives manufacturers.

In welcoming the group, Dr. A. L. Schlecten, chairman of the department of metallurgical engineering at MSM, represented Dean C. L. Wilson who was absent on business. He noted that participation by so many men from the basic sciences of chemistry, physics and mathematics was a healthy and important trend.

At the dinner meeting, Royce A. Hardy, Assistant Secretary for Mineral Resources in the Department of Interior, remarked that "mining research and related technology, stimulated by the free

exchange of thoughts among those qualified—men such as you—form the foundation for the future growth and stability of the mining industry." He later commented that current plans envision that the Interior Department's "major contribution to the long-range development of the Nation's mineral resources is the basic scientific work carried out by [the Bureau of Mines and the Geological Survey.]"

In his talk, Mr. Hardy said: ". . . the secret of America's success . . . is described by the single word 'freedom'. The great productiveness of our economy derives from its reliance on free enterprise."

At the same time, he cautioned, "we must not . . . take continued success for granted. Soviet Russia, operating under an entirely different system, has made very rapid progress . . . has built a substantial mineral . . . industry. In some instances . . . second only to our own . . . they have had, in a single year, several thousand field parties, some with as many as 1,000 members, engaged in exploring for minerals. . . . minerals and metals are important elements in their arsenal of weapons for economic conflict."

Regarding our defense posture in minerals, he said: "Every apparent deficiency has been covered or is being covered by accumulating ready reserves of materials in a strategic stockpile, and additional reserves of strategic minerals in a supplementary stockpile."

Texts of the technical papers are expected to be published shortly and will be available from the Missouri School of Mines and Metallurgy.

"Giants at Little Valley," a movie, illustrated a description of the Promontory Point, Utah, blasts given by John L. Romig, industry manager for quarrying and mining with Atlas Powder Co. The first of these coyote tunnel blasts used some 850 tons of explosive and broke about 3-million tons of fill rock from a hillside. Two larger blasts have since been made. In each case the explosive charge was an 80/20% ratio of Amocol, a bagged nitrocarbonate, and 60% dynamite.

The Ripple Rock Blast, described by C. H. Noren, research engineer at Du Pont's eastern laboratory, employed some 1,375 tons of Nitramex to remove a shoal in the Inside Passage to Alaska. It is believed to be the largest non-atomic blast to date. Planning included model studies of breakage and throw. High speed movies of the blast showed that results were close to those calculated. Tides at the site required an underground approach from shore. Some 1½ miles of shafts, raises and drifts were needed in accomplishing the coyote type blast.

Underground nuclear blasts have pointed the way to a wide variety of uses for mining and other civil works, according to Dr. Gerald W. Johnson, test division leader at University of

(*Continued on p 120*)

Man in the News:

Howard Young—How Many Hours in One Day?

TWENTY-FIVE and fifty can add up to more than seventy-five when you're talking about the accomplishments of Howard I. Young, president of American Zinc, Lead and Smelting Co., and retiring president of the American Mining Congress.

Mr. Young completed 25 years of service as AMC president last year, and, also in 1958, celebrated his 50th anniversary with American Zinc. The fact that AMC's quarter of a century ran concurrently with the latter half of Mr. Young's 50 years with American Zinc would seem to prevent an arithmetical totaling were it not for his record of accomplishment in both offices.

Certainly if an ordinary man gave full time of himself to either office, he could have accomplished no more.

To quote the tribute of appreciation voted by the AMC board of directors, which cited his "untiring efforts and devoted service," the organization during his tenure, "has grown in stature and in public recognition, and has made significant contributions to the advancement of the mining industry of the United States."

The accumulation of years of service becomes astronomical when one includes dollar-a-year duty in Washington during World War II as deputy vice chairman of the War Production Board in charge of metals and minerals, and subsequent labor during the Korean conflict, when he was recalled to the Capital to direct, as Deputy Administrator, the activities of the Defense Materials Procurement Agency.

Not only did Mr. Young succeed in his Government work but at the same time took part in the direction of insurance, telephone and banking firms;

Guidance of Washington University (St. Louis) and Lindenwood College as a board member;

Operation of the American Mining Congress;

Membership in major industry and civic organizations;

An active role in church affairs;

And saw his firm rise from 18th ranking zinc producer to one of the nation's leaders.

The secret of Howard Young's accomplishments is apparent in his own personal creed and in his own life. The creed, "Get thee wisdom . . . but with all thy getting, get thee understanding," explains to a great extent his success with people, with the solution of major and minor problems in industry, civic and personal affairs.

But the secret behind his performance in so many fields in so short a period of time reads right out of Horatio Alger—hard work. During the Washington stints there were no weekends, and there was very little in the way of recreation. A telephone in his hotel room-home in the nation's capital was humming with business affairs during what should have been his free time. —And American Mining Congress, his directorships, and the two colleges and his church were also being served.

. . . Get thee understanding

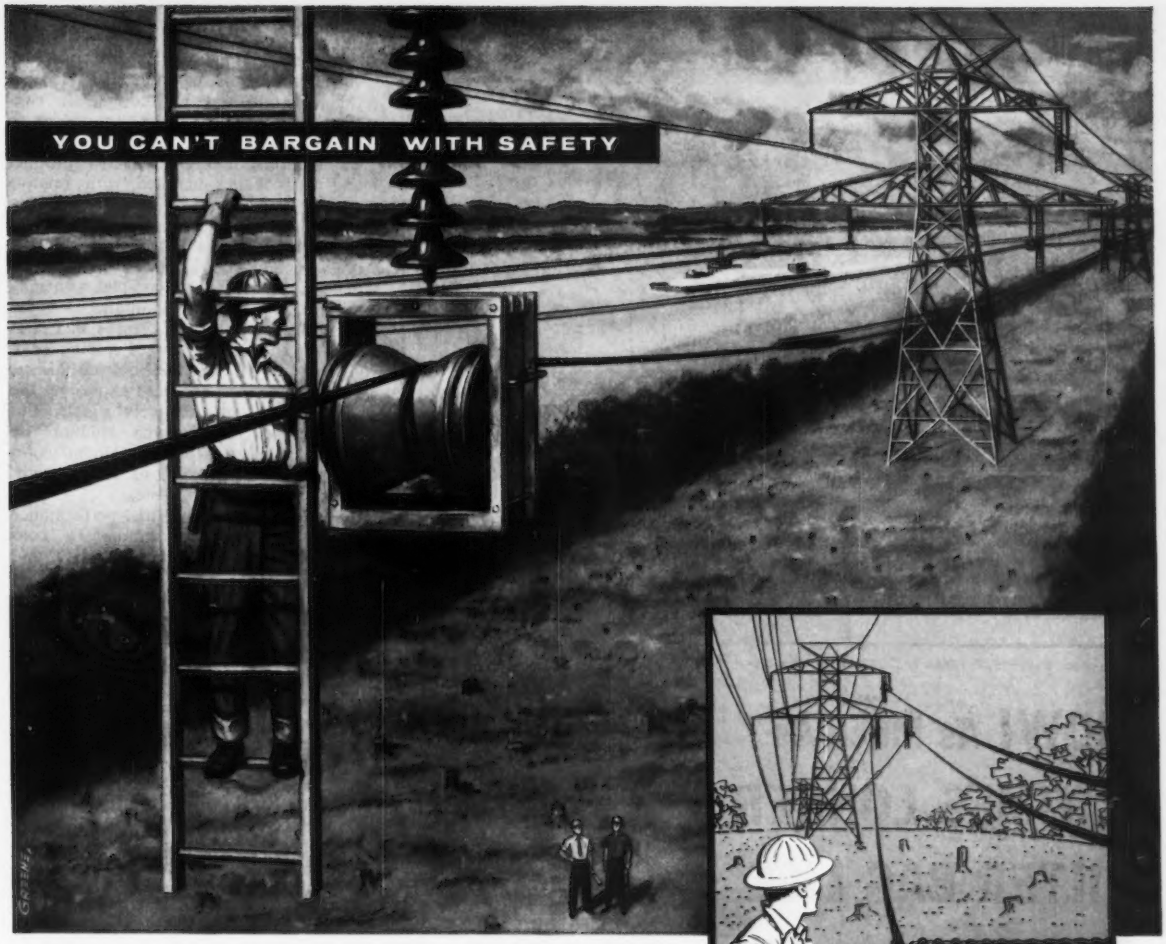
Apparently the habit was formed early.

The son of Isaac and Sallie Davidhouser Young was born in Jasper County, Mo., March 20, 1889. He graduated from high school at Stotts City and attended Queens City Business College at Springfield. At 17, he started work as a bookkeeper for Carthage Foundry Co., near Joplin. He joined American Zinc in 1908 as an accountant and rose to cashier in 1914.

In 1919, at the age of 30, Young was made manager of all Missouri mines of the company, and in 1928, operations in Tennessee, Wisconsin and Montana were added to his management duties. He then became a vice president of the firm and American Zinc properties in Illinois and Texas were included in his bailiwick. In 1930 he became president of American Zinc.

Mr. Young himself provides the final, and perhaps most important part of the story. "When you grow up in a company and you thoroughly enjoy the work, you will tend to keep your fingers in a little bit of everything." He can still talk shop with a shift boss, a prospector, and an accountant, and is equally communicative and constructive in conversation with his fellow executives and Government leaders. One of the latter, in conversation with a journalist at the recent San Francisco meeting of AMC, said in quiet awe, "Howard Young has more friends than anyone I know in the whole Congress of the United States."

Mr. Young is succeeded as president of AMC by Raymond E. Salvati, president of Island Creek Coal Co.



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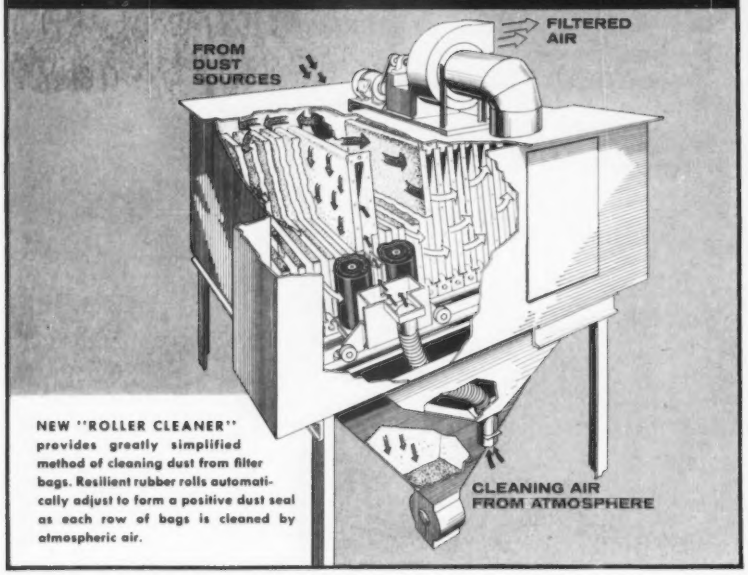
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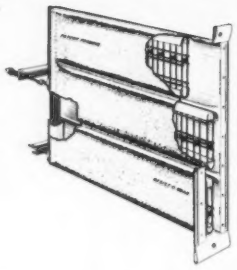

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Missouri Blasting *(Continued)*

California Radiation Laboratory. Five subsurface shots have been made and the last one was not completely contained. In the first blast, equivalent to 1,700 tons of TNT, a fused rock shell was the only highly radioactive product and it is being handled with relative ease.

The mathematics needed to calculate such properties as detonation velocity, pressure and temperature for some explosives becomes very complex and may involve 20 or more simultaneous equations, according to Dr. George B. Clark, head of the department of mining engineering at Missouri School of Mines. For most oxygen balanced explosives the computations are relatively simple. But for complex cases, even solution on desk calculators is tedious. Digital computers and some types of analog computers are more adaptable.

Digital computing of performance factors requires programming a considerable amount of tabular data and many equations, but some of the tables and curves can be inserted as equations. In any event, Donald J. Kaufman, mathematician in the applied mathematics section of Monsanto Chemical Co., indicated that the digital computer is a great time-saver over a standard desk calculator.

Methods of calculating the results of explosive reactions require many revisions in order to make the answers agree with original assumptions, according to the paper by Jack Alster, physical chemist at Picatinny Arsenal.

Strain pulses in rock have been found to decay in peak value on an exponential curve with distance and with charge weight. In his paper, Wilbur I. Duvall, supervising physicist in charge of blasting research at the applied physics laboratory of the Bureau of Mines, also reported that the peak increases linearly with calculated detonation pressure and with calculated energy per unit volume; that it decreases linearly with the elastic constant of the rock; and that it is limited by the rock independently of the explosive type although no correlation with physical properties of the rock could be established.

AN-TNT slurry explosive was evaluated by M. A. Cook, professor of metallurgy and director of explosives research group at the University of Utah. In describing the compound, he said the preferred TNT is a coarse "shot-tower" product currently sold under the name "Pelletol" in the U.S. and "Nitropel" in Canada. This is not cap-sensitive and thus safer than flaked or fine grained TNT. He also remarked that initiation of AN-oil or AN-TNT slurry mixes with heavy 400-grain detonating fuse produces an inferior explosion.

Water slurries of AN sensitized with TNT are higher strength explosives than the dry mixes, according to J. F. C. Dixon, research manager of the research department of the explosives division of Canadian Industries Ltd. Although the slurry had a tendency to segregate, this property has now been modified and

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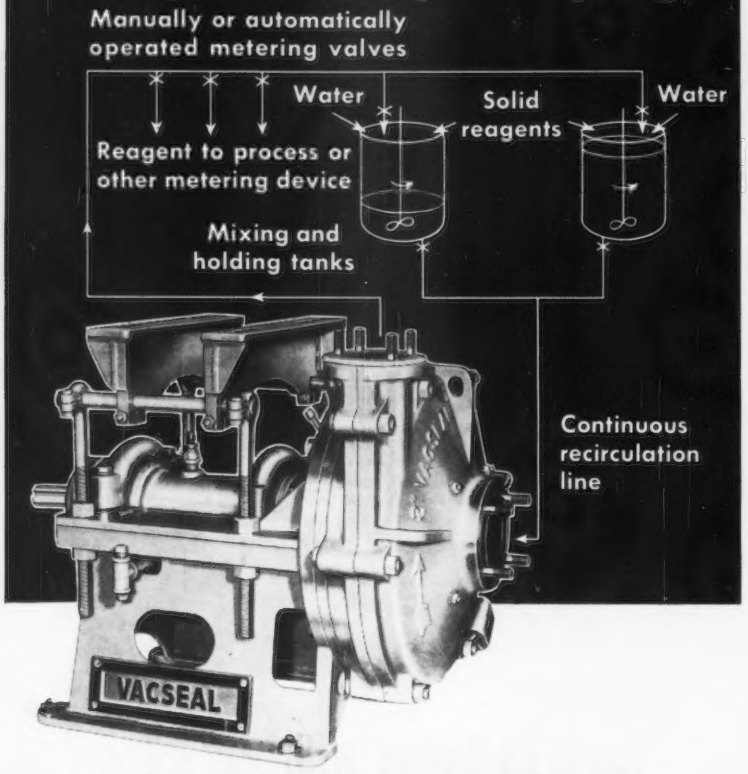

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Blasting *(Continued)*

water tolerance has been further enhanced. The slurries can be packed and shipped from a central manufacturing plant or they can be locally compounded for either package or direct bulk charging into water filled holes.

AN-TNT water slurry has a material cost of 7.75c per lb as compared to 4.5c per lb for AN-oil at Iron Ore Co. of Canada. But on the cost per ton of rock broken it is much cheaper. In describing their field practice, H. E. Farnum, manager of operations, also mentioned a low-cost 6-oz primer-booster of cast pentolite. Using the slurry, hole spacing on 10-in.x40-ft holes was raised to 21x23 ft as against 15x15 ft for AN-oil. Recent tests with 6½in. holes on 16x16-ft spacing were successful.

Factors causing air-blast damage can be calculated through methods outlined by Rufus C. Ling, supervisory physicist in the explosive research section at Picatinny arsenal.

Statistical approach to testing can be used to advantage in evaluating explosive performance, according to R. L. Grant, chemical engineer, and R. W. VanDolah, of the division of explosives technology in the Bureau of Mines.

Fumes from AN-oil explosions must be just as carefully considered as when using conventional explosives underground, is one conclusion in the report on the Bureau's work which was prepared by W. E. Tournay, G. H. Damon and Mr. VanDolah, of the division of explosives technology in the Bureau.

Physical and chemical composition of AN explosives as related to performance was detailed by R. F. Bruzewski, associate professor of mining engineering at MSM, in his presentation of a paper which Dr. Clark, Joseph J. Yancik, research engineer, and K. M. Kohler, research assistant, and he prepared. Oxygen balanced mixes are most powerful; a small amount of inert coating increases detonation velocity in fuel oil mixes, as does smaller particle size, greater density and larger charge diameter. No. 2 fuel oil appears to be the best fuel for dry holes.

Properties and performance of AN blasting agents were further covered in the final paper by R. D. Doddorff of the technical service department of Hercules Powder Co.'s explosive division. In the paper, the authors, which also included R. W. Lawrence, manager of the explosives division, and R. Simmons, research chemist, reviewed developments which have led to the wide use of a 94/6 weight percent mix of fertilizer grade ammonium nitrate prills and No. 2 fuel oil. But, they stated, sight should not be lost of the fact that crystallized AN has higher detonation velocity, loading density and reliability of propagation; and that prepackaged Hercules Dynatex can often show cost savings.

Rock Mechanics Session At Colorado Set For April

PLANS for a Third Symposium on Rock Mechanics to be held at Colorado

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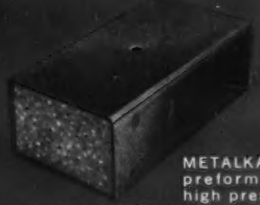

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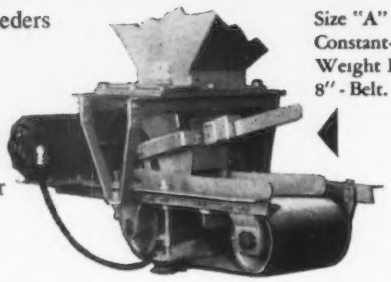

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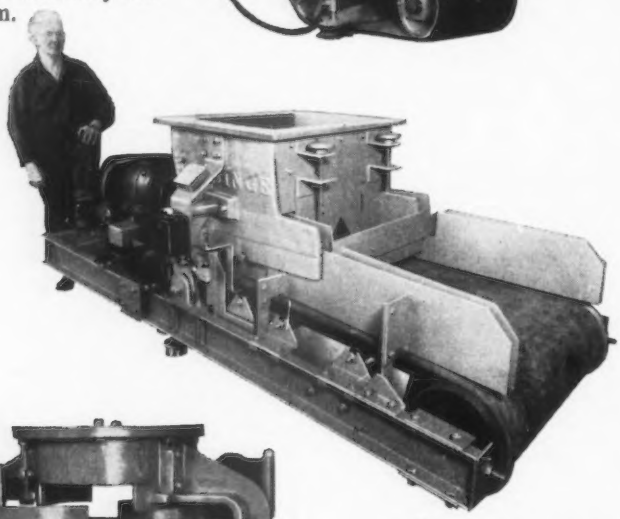

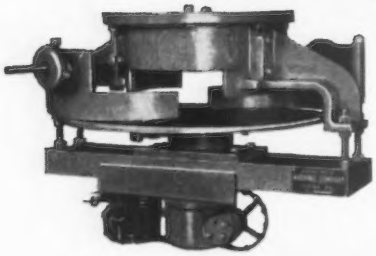

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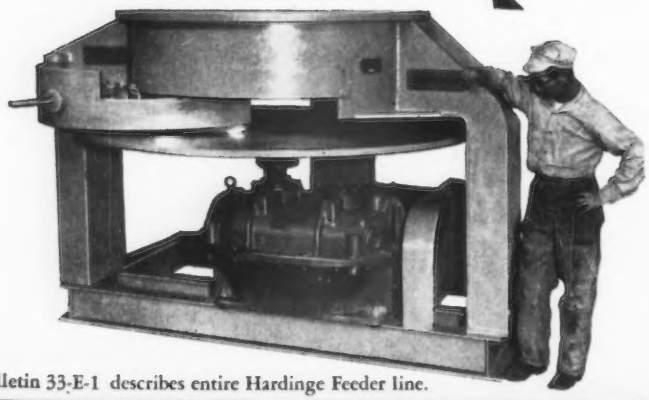

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Rock Mechanics *(Continued)*

School of Mines on April 20-22 are rapidly turning into fact. According to Prof. Lute J. Parkinson, head of the department of mining engineering, the four half-day sessions will deal with:—

Factors of rock failure common to: (1) comminution, blasting and collapse of openings; and (2) soil mechanics. (3) seismology and explosions. (4) nuclear blasting. Formal sessions will be followed by a field trip to the School's experimental mine and the Schwarzwalder uranium mine.

Participation of operators, engineers and researchers in this "conference of basic concern to all those engaged in mining" is invited by the arrangements committee. In the past, attendance has approximated 200. Liberal discussion time has been scheduled following each of the three half-hour papers to be given by competent authorities at each session. At least one leading foreign scientist will review overseas developments.

Moderators for the sessions will be: Fred C. Bond, consulting engineer, Allis-Chalmers Co., Milwaukee, Wis. (comminution); Robert R. Philippe, consultant, US Army, Alexandria, Va. (soil mechanics); C. W. Livingston, president, Barodynamics Inc., Wheatridge, Colo. (seismology and explosion); and Robert Stefanko, professor, department of mining engineering, Pennsylvania State University, University Park, Pa. (nuclear blasting).

Sponsorship of the symposium is shared by the departments of mining engineering at Colorado School of Mines, University of Minnesota and Pennsylvania State University on a rotating host plan designed to increase geographic representation and dissemination of knowledge. This over-all program also includes symposia on Drilling & Blasting (recently held at Minnesota) and Exploration Drilling (to be held at Penn State later this year).

Directly supervising the program is Prof. Parkinson with the assistance of an arrangements committee comprised of: Prof. Eugene P. Pfleider, head, division of mineral engineering, University of Minnesota; Dr. Howard L. Hartman, head, department of mining, Pennsylvania State University; H. K. vanPoolen, Ohio Oil Co. Research Center; L. E. Antonides, *Engineering & Mining Journal;* R. M. Stewart, Anaconda Co.; Adolph Soderberg, Kennecott Copper Co.; the moderators mentioned above; and the staff of the department of mining engineering at Colorado.

IN THE U.S.

COLORADO

Gold Receipts at the Denver Mint declined to 66,717 oz worth $2,335,120 in October from 70,661 oz valued at $2,473,158 in October, 1957, mint officials report. Silver receipts were up to 571,031 oz valued at $516,736 from

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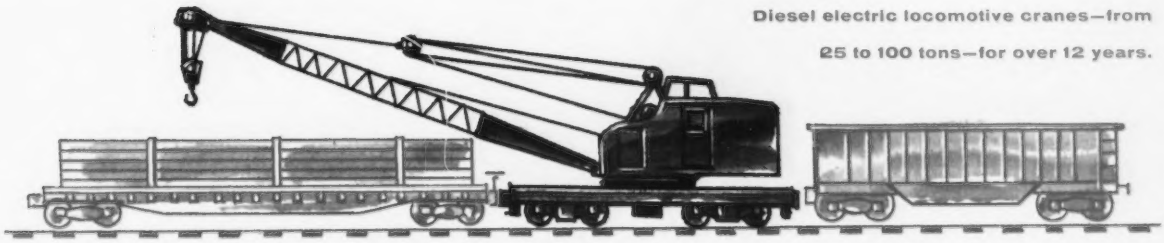
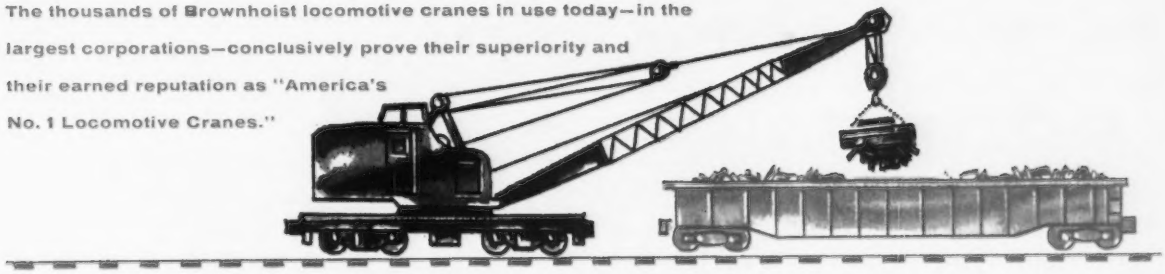
Industrial Brownhoist Corporation has been engineering and building locomotive cranes since 1873—Diesel electric locomotive cranes—from 25 to 100 tons—for over 12 years.



The thousands of Brownhoist locomotive cranes in use today—in the largest corporations—conclusively prove their superiority and their earned reputation as "America's No. 1 Locomotive Cranes."



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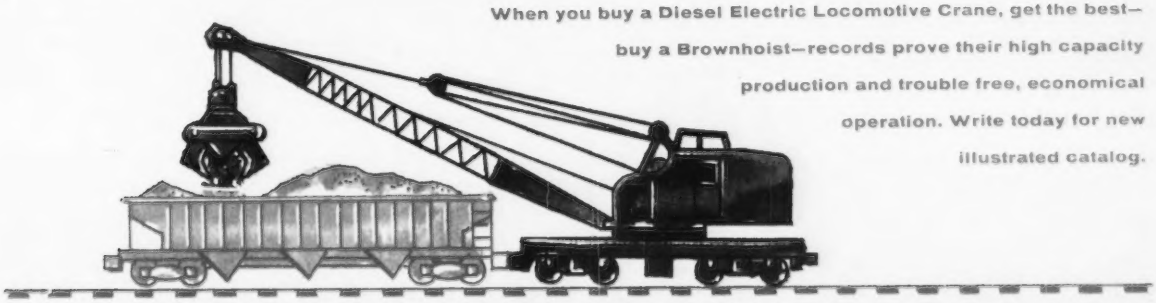

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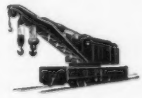
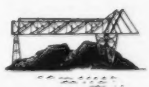
BROWNHOIST

CLAMSHELL BUCKET



250 TON WRECKING CRANE



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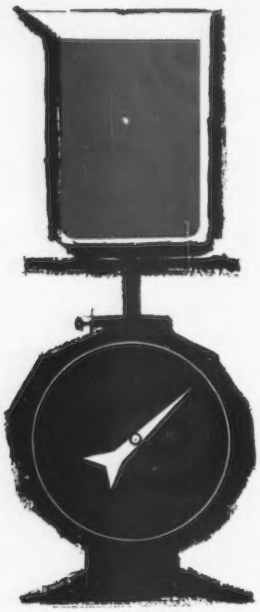
CAR DUMPER

LOCOMOTIVE CRANE

INDUSTRIAL BROWNHOIST CORPORATION, BAY CITY, MICHIGAN • DISTRICT OFFICES: New York, Philadelphia, Cleveland, Chicago, San Francisco, Montreal, Canada • AGENCIES: Detroit, Birmingham, Houston

more pounds per gallon



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EVAPORATOR CONTROL SYSTEM

Only an AccuRay Continuous Process Analyzer and Level Control System senses density and level independent of other product characteristics. More pounds per gallon are obtained by minimizing process variable spread. The AccuRay Process Analyzer, external to the process, continuously measures total solids in both solutions and slurries to accuracies of ±.001 specific gravity. The AccuRay Level Control System maintains liquid level to ±⅛ of an inch.

In the diagram of a forward feed evaporator system shown below, a level control system on the exterior wall of each evaporator maintains constant solution level. The Density Control System on the last effect maintains crystallized product at the highest possible pounds per gallon, with minimum fuel cost.

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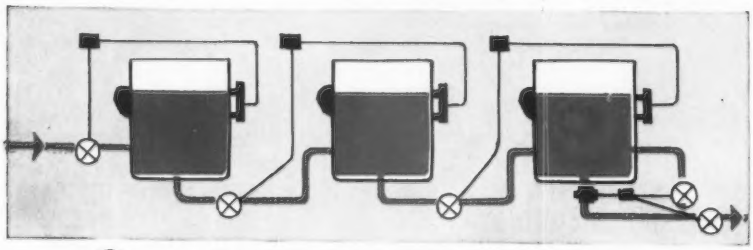

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Colorado *(Continued)*

14,861 oz worth $13,422. Within the past year the world price of the metal has moved below the fixed U.S. Government price of 90½ cents an oz, turning the metal sales to the U.S. mint.

J. Cameron Grant, president and general manager of the Argyle Mining & Milling Co. said at Silverton that the Pride Mill will reopen after having been shut down for repairs. Other plans to open the Pride mine are formulating. Exploratory work will include part of the plan.

Exploration and development drilling for uranium ores in Colorado increased from 1.1-million ft in 1956 to 1.2-million ft in 1957. Footage drilling in underground workings declined from 84,000 ft in 1956 to 65,000 in 1957. Other forms of exploration in 1957 included 1,000 linear ft of trenching and 1.4-million cubic yd of material moved by stripping.

Dr. Margaret Fuller Boos, and her partner-husband in geologic consulting, C. Maynard Boos, are engaged in exploration work for the National Beryl & Mining Corp., which holds a lease on 1,340 acres of beryllium and other rare earth deposits near Estes Park. Site of the development is in the Storm Mountain area whose deposits Dr. Boos herself discovered 20 years ago while on the faculty of the University of Denver.

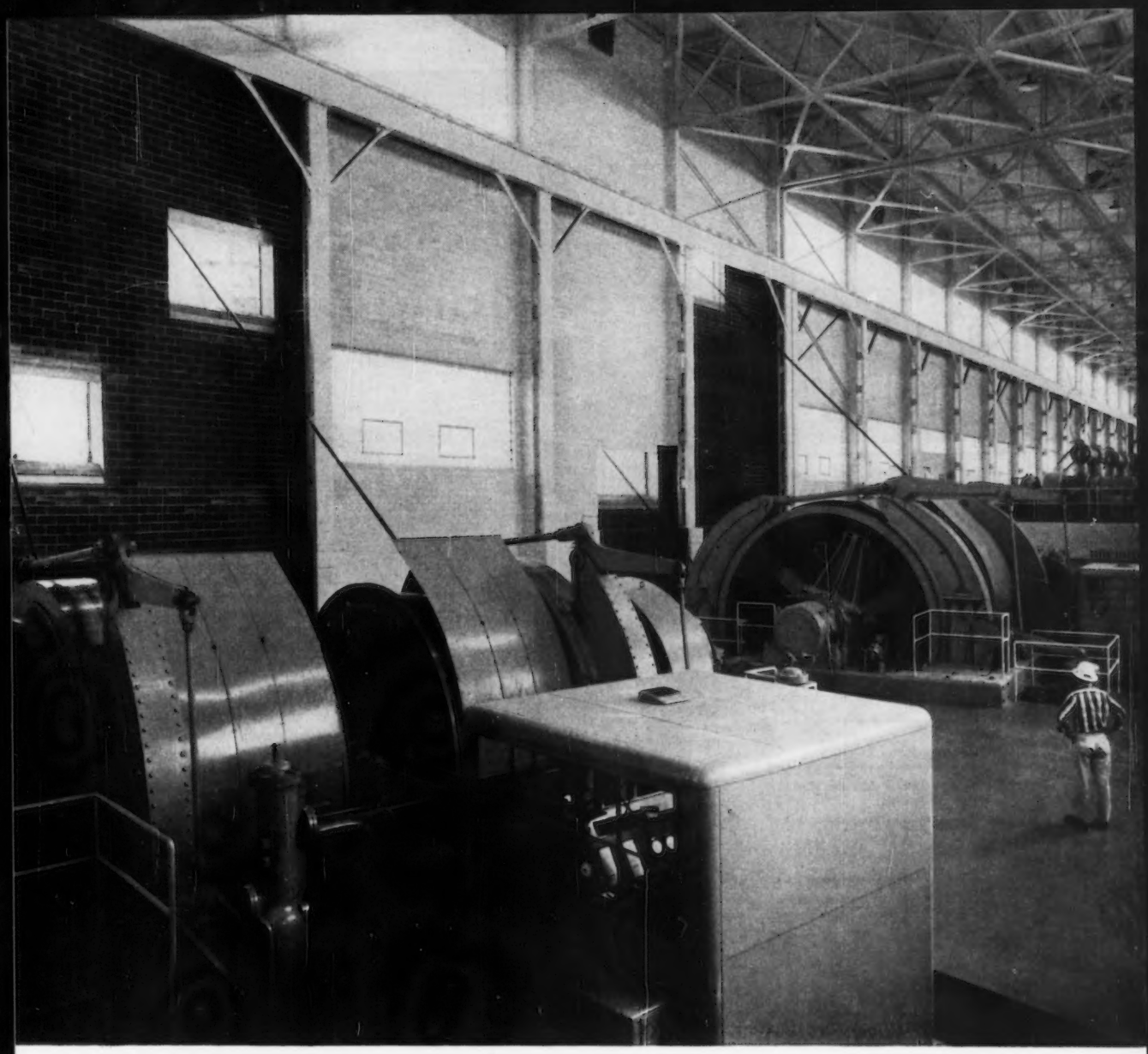
The 23-mile Roberts' Tunnel, a 50-million dollar water supply project for the City of Denver, passed the halfway mark according to D. P. Morse in a talk before the Denver Mining Club Oct. 8. The 12½-ft horseshoe section is being driven from each end and from a center shaft out both ways. The East Portal has passed 35,000 ft and will reach about 55,000 ft—one of the longest single headings ever driven.

Work has started on a shaft in Virginia Canyon near Central City on the Hot Pot mining claim to connect with the Lucania tunnel which traverses some rich veins, part of the property belonging to the Fall River Power & Mining Co.

IDAHO

Wallace Woolf, vice president of Bunker Hill Co. at Kellogg, Idaho, told the fall meeting of the North Idaho Chamber of Commerce that free world consumption of lead may overtake supply sometime in the early 1960s. He said the same thing would happen to zinc a year or two later. Woolf spoke at Moscow, Idaho, Nov. 14, at the opening session of the chamber's fall meeting.

Fault complications have considerably slowed deeper development by Silver Star-Queens Inc. at its Queens property in the Mineral Hill District of Blaine County. A major fault was encountered in the winze at about the 750-ft horizon, and the sinking continued in extremely heavy ground to the 900 depth objective.



Powerful Hoisting Equipment for 2250-ft Shaft. Visible in this neat, efficient layout are hoists for a man-and-materials cage and balanced skips. They're part of the surface equipment of an Eastern iron-ore mine where good housekeeping is a fundamental rule. The shaft served by this installation is approximately 2250 ft deep; circular in shape, it has a diameter of 21 ft 6 in.

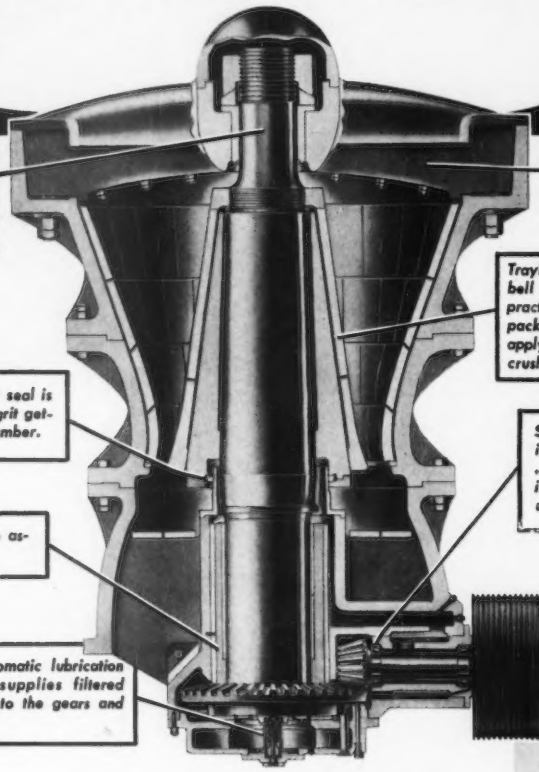
The skips, each of 20-ton capacity, operate at 2500 ft per min. The cage can be run at better than 1400 ft per min. Ropes for the hoists are Bethlehem flattened strand, Type H construction, with lang lay and fiber core. Strong and tough, these durable steel cables are more than a match for the heavy demands imposed upon them.

Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Mill depots and distributors from coast to coast stock Bethlehem Wire Rope.

BETHLEHEM STEEL

Traylor-MADE TC GYRATORY CRUSHER



Main shaft, forged of low carbon high grade steel, is of minimum length but of maximum diameter for greater strength.

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Bronze bushed eccentric to assure longer life.

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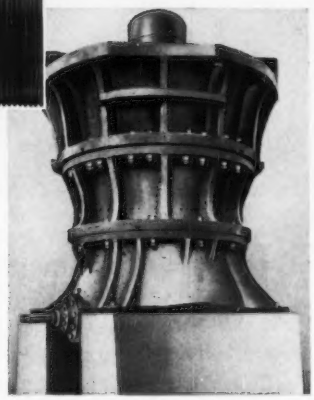
TC Gyratory Crushers are made in 7 sizes with feed openings 20″ to 60″ and capacities from 1,240 to over 32,000 tons per eight hour day. These crushers are in use by many leading producers throughout the world. For specifications write for Traylor bulletin No. 1126 today!



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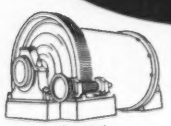

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ROTARY KILNS

APRON FEEDERS

PRIMARY GYRATORY CRUSHERS

JAW CRUSHERS

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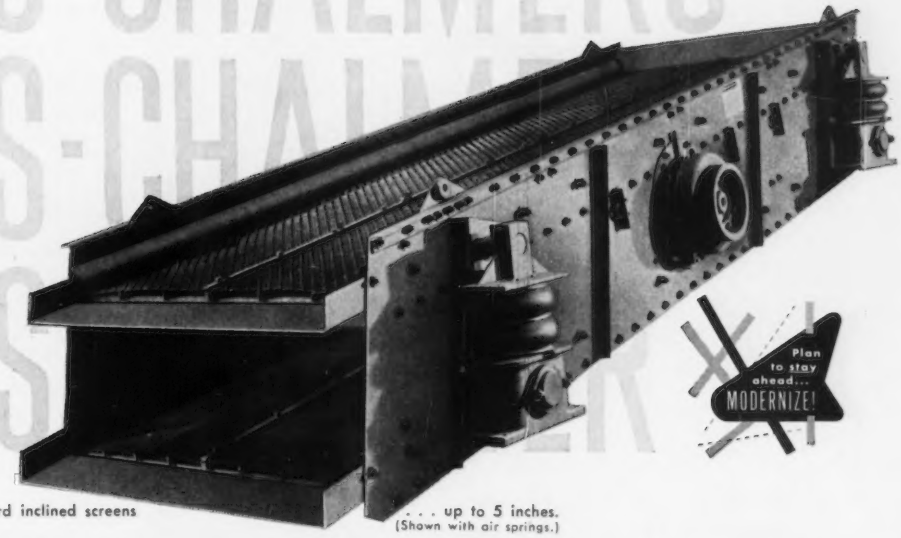
ALLIS-CHALMERS

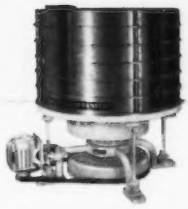


Standard inclined screens . . . up to 5 inches. (Shown with air springs.)

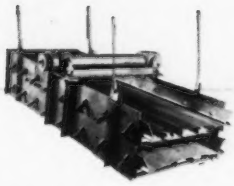
SCREENS

world's most complete line!

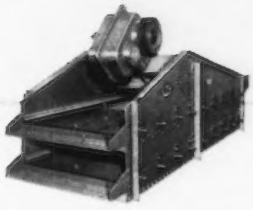
separations from 12 inches to 325 mesh



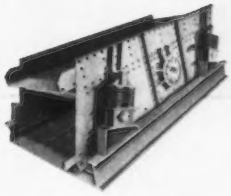
All-metal gyratory screens . . . 2 to 325 mesh.



Small inclined vibrating screens . . . 1½ inches to 40 mesh.



Horizontal vibrating screens . . . up to 2½ inches.



Heavy duty scalping screens . . . . up to 12 inches.

Expert application help. Allis-Chalmers not only offers the most complete line of dependable, high-production screens, but also provides expert counsel based on unequaled experience in screen applications. In addition, modern pilot plant facilities are available for test runs of difficult or untried materials, if necessary.

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SUPER MATERIAM IGNIS TRIUMPHANS

J. K. SMIT & SONS, INC.

HOME OFFICE AND PLANT

MURRAY HILL NEW JERSEY

TORONTO, ONTARIO, CANADA

Idaho *(Continued)*

Uranium mining and exploration in the Stanley Basin of Custer County reached the proportions of a minor boom this year as several large companies entered the field. Top producer was Western Fluorite Corp. of Warren, Ark., which shipped 22 carloads of commercial ore from a 15-claim property on East Basin Creek owned by Keith and Alice Evans of Ketchum. Phillips Petroleum Co. shipped 15 carloads from the Little Bill claims on Cold Creek, owned by Bill Brooks, Melvin Peterson and Jules Kauffman, all of Hailey. Other firms actively exploring properties in the area were Sidney Mining Co. of Kellogg and Rare Metals Corp. of America, a subsidiary of El Paso Natural Gas.

Bunker Hill Co.'s electrolytic zinc plant west of Kellogg marked its 30th anniversary during November. The first 60-lb. slab of 99.99% pure "Bunker Hill" brand special high grade zinc was poured Nov. 6, 1928, and is still on display in the company's main Kellogg office with an inscription that the initial production coincided with the election of Herbert Hoover as president of the United States.

Facilities for production of important by-products have been added over the years. In its 30 years of operation the plant has produced 1,031,376 tons of Special High Grade zinc, 9,954,000 lb of cadmium metal and 299,999 tons of sulphuric acid.

Seventy miners have been laid off at Calera Mining Co.'s properties in closure of underground operations, according to Ed Douglas, superintendent of the affiliate of Howe Sound Co.

Mr. Douglas said that operations would continue at open pit, which has a limited life. Total open pit and underground operations the last year have produced at rate of between 1,000 and 1,300 tpd of copper-cobalt ores.

MARYLAND

Ground has been cleared and preliminary construction work has begun on Kennecott Refining Corp.'s new 16,500 ton per month electrolytic copper refinery, located near Baltimore.

The refinery is being engineered and built by the M. W. Kellogg Co. from Kennecott's project design.

The $30-million refinery will employ approximately 570 people and is expected to be in operation in 1959.

MINNESOTA

Reserve Mining Co. completed its shipments of taconite pellets on Nov. 22 when its stockpile at Silver Bay was "virtually cleaned out." The plant will operate through the winter.

The Duluth-Superior docks shipped 3,648,905 tons in October, 1958, compared to 5,646,429 tons in October 1957. Total shipments from U.S. and Canadian

NEW CHEVROLET 4-WHEEL DRIVE ENABLES YOU TO HAUL WHERE YOU COULDN'T BEFORE!

Model 3684 Fleetside Pickup

Chevrolet's new 4-wheel drive really digs in and does it . . . enables you to haul through deep mud, snow, swampy areas and up towering grades. With up to twice the traction, wheels are able to grab hold and go!

Here's the latest thing in 4-wheel drives! A rubber-mounted power divider with precision-engineered front axle distributes power evenly to front and rear axles. And when the going is extremely difficult, it directs power to whichever axle is getting the best traction. Result: Your load goes through, whether the road does or not!

EASY SINGLE-STICK CONTROL

Shifting between 2-wheel drive and 4-wheel drive can be done whether the truck is stopped or moving. Lever has these 4 positions: (a) 4-wheel drive, (b) neutral, (c) 2-wheel direct, (d) 4-wheel direct.

CHEVROLET 4-WHEEL DRIVE SUITS MANY MODELS

There are Chevrolet 4-wheel drive *pickups* for ploughing, grading, snow removal jobs, and others . . . *panels* for surveying, delivery, and construction tasks . . . *Suburban Carryalls* for sportsmen and tough cargo-and-passenger-carrying jobs . . . *stakes* for work that calls for heavy back-country hauling . . . and *chassis-cabs* for a broad range of special applications!

PROVIDES POWER FOR SPECIAL EQUIPMENT OF MANY KINDS

With *four* power takeoff outlets, Chevrolet 4-wheel drive can be used to operate saws, winches, generators, pneumatic hammers, post-hole diggers, back hoes, and many more!

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See your nearby Chevrolet dealer about versatile 4-wheel drive in

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The Mining Machines You'll

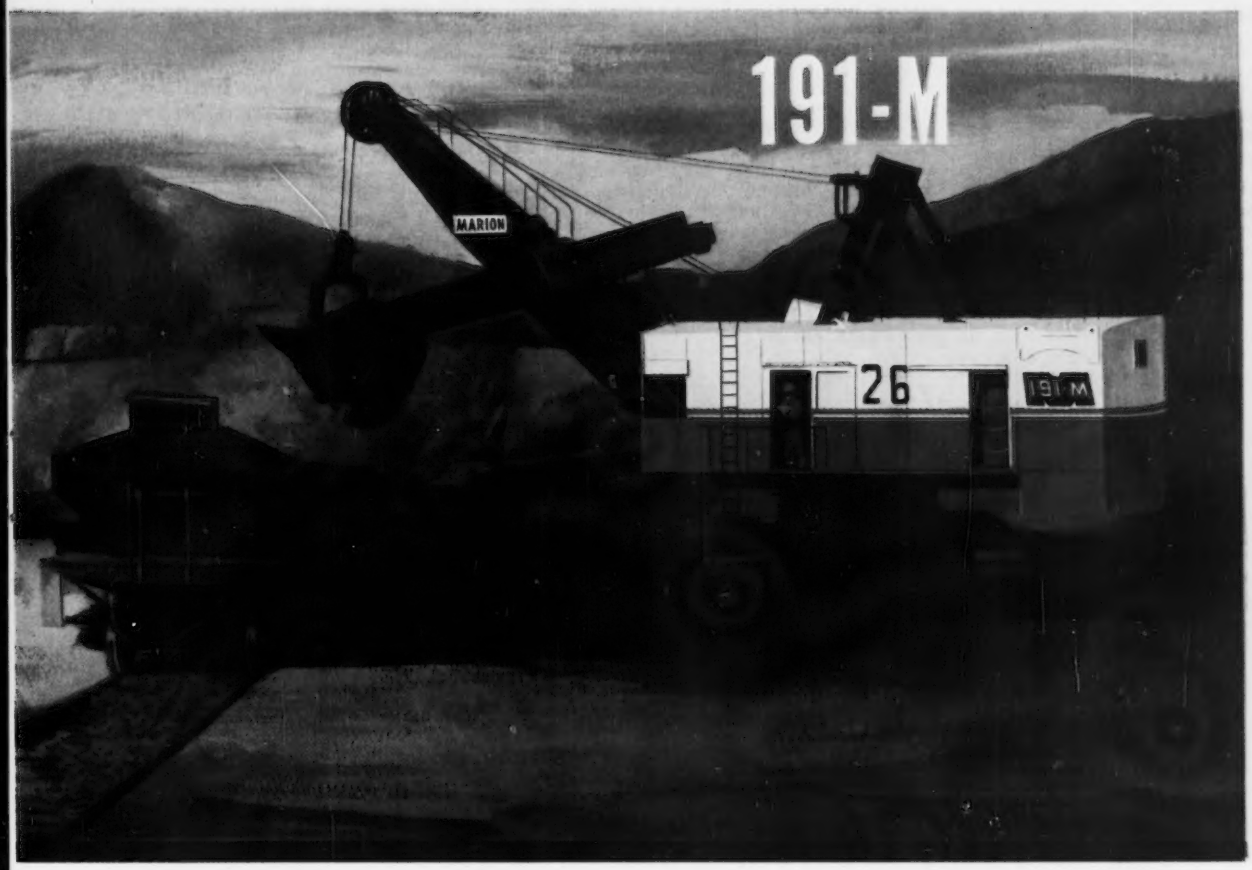
YESTERDAY, Marion rail-mounted steamers were the marvel of their era, taking back-breaking labor out of loading and helping giant industries move toward big production.

Field tested, ready and waiting, these are the Marion machines that will help write the next chapters of progress in world mining history.

Teamed with larger haulage units, they cut wider benches, cut track moving time where rail cars are used and open new areas of low-unit-cost efficiency in the pit.

Big, bold and burly, they load more, faster, cheaper.

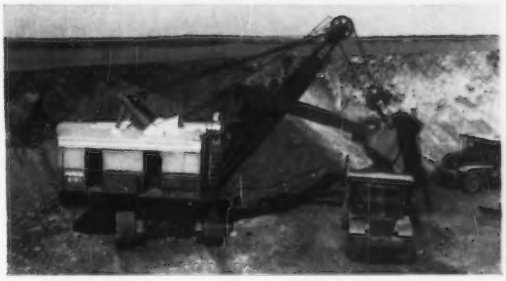
You get **MORE** *with* **MARION**



Need in the 1960's

The Marion 4161 and Marion 151-M cut open pit mining costs so consistently that they became the standard machines for the industry. That history will be repeated on a bigger scale as the Marion 181-M and Marion 191-M come into their own in the copper and iron pits in the decade ahead.

Far-sighted management men with a reputation for cashing in on the advantages of being the first to adopt new operating efficiencies will want the details about these great new Marions. Let's talk facts and figures.



TODAY, the daily output of Marion 4161 and 151-M machines in the open pit mines sets industry standards for costs. Dependable Marions will continue to mine a big percentage of the world's ore for years to come.

MARION POWER SHOVEL CO. — MARION, OHIO

A Division of Universal Marion Corporation

Minnesota *(Continued)*

ports in October 1958 were 8,480,635 tons, 2,525,009 less than in October 1957. Total season shipments from these ports to Nov. 1, 1958, were 48,264,152 tons, 32,265,392 tons less than one year ago.

Dr. E. W. Davis has said that there will be no further taconite expansion in Minnesota until the state's leaders agree on a new tax program. He said Minnesota is geared to expenditures of $50-million per year from a "dying iron mining industry." Investors ask where this income will come from as direct shipping and wash ores become depleted. A taconite plant, he said, costs between $200- and $300-million, which industry must borrow, with interest alone running to about $20,000 per day.

The Erie Mining Co. taconite plant will operate through the winter. It is expected that the big plant will be running smoothly by spring with most of the "bugs" that accompany such a large installation removed.

Ore loading at Mesabi range mines ended for the 1958 season Nov. 26 with the M. A. Hanna Co. mines furnishing the last ore. Washing plants were all closed down before early November and mining companies began completing their schedules by the middle of the month. In a busy year, the shipping season often extends into December.

LIDDICOAT

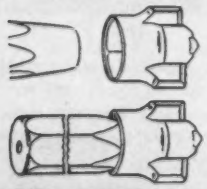
. . . the tungsten carbide bit that needs no resharpening

Illustrated is the popular Liddicoat uranium country bit made to withstand drilling in highly abrasive rock

The exclusive shallow long life inserts need no resharpening because they do not develop a reverse taper dullness . . . a condition that stops drilling in the conventional multi-use bit. The exclusive design of LIDDICOAT permits fast drilling far beyond the point where conventional multi-use carbide bits must be withdrawn from service for resharpening. Fast drilling continues during the entire bit usage without need of resharpening. Lower first cost — low cost per foot of hole drilled.

Taper socket —
No threads —
Fast, firm attachment

The type TS Tee Cee Liddicoat (no resharpening) bit has a completely new short taper socket connection. Within the socket of the bit is a brass shim. The socket, which is completely forged, is tapered to correspond to the taper placed on the drill rod. The connection assures an absolute attachment to the rod, and yet permits easy removal.



For All Sizes of Drill Rod -- 7/8" to 1½" Forged for Toughness from Nickel Alloy Steel

WESTERN *Rock Bit Manufacturing Company*
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MICHIGAN

Shipping from Menominee range mines ended about Thanksgiving day and stockpiling for the 1959 season began. Total shipments from the Escanaba docks for 1958 are expected to be approximately 3.3-million tons compared to 5,907,597 tons in 1957. Escanaba is usually the first iron ore port on the upper lakes to open in the spring, and the last to close in the fall. Its favorable location on Lake Michigan makes it unnecessary to wait for the ice to clear from the locks at Sault Ste. Marie and Whitefish Bay which often delay Lake Superior harbors: Duluth-Superior, Two Harbors, the two new taconite harbors in Minnesota; Marquette, Mich. and Ashland, Wis.

The Lake Superior Mines Safety Council met at Negaunee Dec. 3. A discussion of emergency first aid and rescue procedure was lead by Louis J. Zaverl, U.S. Bureau of Mines at Duluth. Other panel participants, Marvin Swanson and Roy Lukkarinen of Cleveland-Cliffs Iron Co.; Robert Silas, Inland Steel Co. and Roy Kivisto, Jones & Laughlin Steel Corp. A discussion on safety responsibilities of foremen was headed by H. D. Scott, director of industrial and public relations, Calumet & Hecla, Inc. Panelists were Howard M. Graff, mines manager, Inland Steel Co.; Hugh J. Leach, Michigan mines manager, Cleveland-Cliffs Iron Co.; F. J. Haller, vice-president of operations, North Range Mining Co. and Robert W. Braund, manager of Michigan division mines, J. & L. Steel Corp.

MONTANA

Subleasing of a Beaverhead County mining operation on state land was authorized on Nov. 12 by the Montana Land Board.

Eva Smith, chief of the board's mineral section, told the board such subleasing would allow development of what could be one of the state's largest manganese strip mines.

The action will permit Sodak Uranium Mining Inc. to sublease the operation to Gustave Ring, Washington, D. C.

Mrs. Smith said the request for the sublease was made in an effort to obtain enough funds to operate the mine.

Anaconda Co. has decided to continue electrolytic zinc production at its reduction works in Anaconda, a company official said on Nov. 28.

William Kirkpatrick, the firm's western general counsel, said the decision was reached after union workers voted to increase the number of tanks of cathodes to be stripped in the zinc tank house.

The decision reversed a company announcement made Nov. 26, that the

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- ★ Easy to handle and install . . . even over rough terrain
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NEW BATTERY PLATE CONSTRUCTION

Unique new double-sleeve, multi-tube positive plate construction permits greater volume of active material per tube and greater accessibility of electrolyte to the material — providing greater capacity for brighter, better light with no increase in plate size. Long battery life with increased resistance to vibration and hard use are plus advantages.

A PERFECT SPOT

at your fingertips — either filament!

A finger-turn of the switch knob lights either filament of the powerful equal-filament bulb—and at the same time achieves a perfect, brilliant spot! No tools, no fuss or tinkering. Anyone who can turn a switch can focus an ideal spot with WHEAT—instantly!

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Advanced, exclusive new battery construction joins with efficient new krypton-filled bulb to achieve unrivalled light output in a miner's electric cap lamp today . . . 30% more light than even the high-powered Wheat Forty-niner! For the *most* light for the miner throughout the working shift, specify WHEAT NATIONAL.

TWO WORKING FILAMENTS

in Krypton gas-filled bulb

Each of the two identical filaments in the new Wheat krypton-filled bulb is a full-power working filament. If one burns out, the other is instantly available at equal high brightness—and is focussed instantly to an equal perfect spot. Only WHEAT NATIONAL offers this operating ease!

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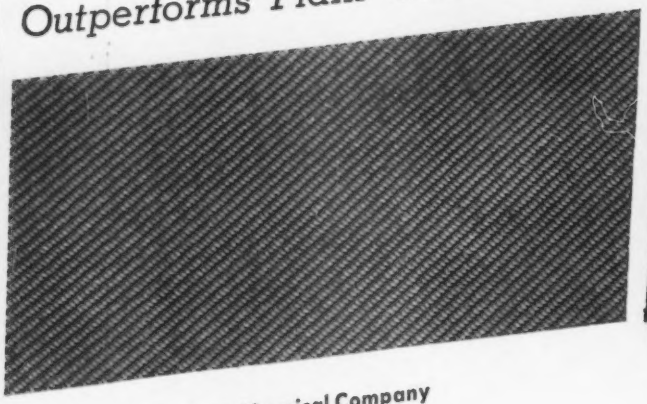

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Type Filter: 24" 4-eye c.d. Washing Type
Filtering: Thorium Hydroxide Slurry (Density = 1.2)
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Average Daily Operating Time: 16 hours
Average Life of NFM CR Treated Cotton Cloth: 2 weeks
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Montana *(Continued)*

Anaconda plant would suspend operations on Dec. 11, because the union refused to increase production with new equipment to 18 tanks per shift from 12. The company had planned to transfer production to the company's Great Falls plant, which the company said has produced zinc at a much lower cost than at Anaconda.

However, after the transfer announcement, members of Local 117 of the International Union of Mine, Mill and Smelter Workers (Ind.) voted 35-20 to strip 15 tanks per shift for a 30-day break-in period, then increase production to 18 tanks.

About 250 employees are affected.

"We have decided not to move the plant on Dec. 1," Mr. Kirkpatrick told newsmen. "But whether it will be moved in the distant future depends on the economic picture."

The company said increased production was possible at the Anaconda plant because of recent installation of air hoists replacing hand-operated and hand-transported chain hoists.

A pilot plant to produce ferrochrome is in operation at Nye in Stillwater County 45 miles south of Columbus.

American Chrome Co. built the electro reduction plant to test the feasibility of marketing ferrochrome in competition with foreign ore.

None of the ore used by United States industry last year came from domestic sources, company officials said.

Willis A. Swan, president, and John Bley, general manager, pointed out that ferrochrome produced from foreign ore contains 65% chromium. The Montana ferrochrome will contain 53% chromium, a grade which the steel industry is using.

NEW MEXICO

Central Farmers Fertilizers Co. and National Potash Co. have signed an agreement which calls for the acquistion by Central Farmers of a stock interest in National and the production by National of potash materials for distribution by Central Farmers, according to a formal announcement made jointly by Richard C. Wells, president of National, and J. J. Lanter, president of Central Farmers.

The perlite mill now under construction in Taos county by United Perlite Corp., controlling interest in which is held by United Western Minerals, was to go into operation the middle of December.

NEVADA

Apex Minerals Corp. has received the final draft of the AEC contract which assures construction of a 200-ton uranium mill near Austin, as soon as arrangements can be worked out. The contract assures Apex that the AEC will buy its mill output for five years after the new structure starts operation. On Jan. 10 a meeting of Apex stockholders

Look how these drillers are cutting footage costs with HOFFMAN ORIENTED DIAMOND DRILL BITS

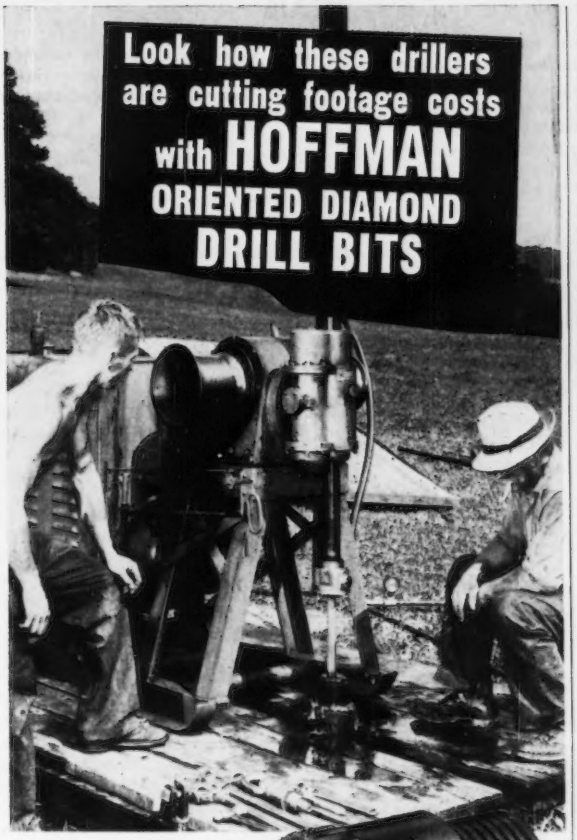

Photo courtesy Acker Drill Co.
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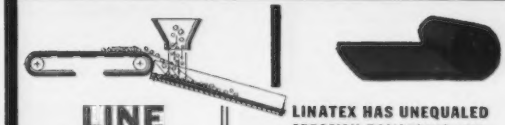

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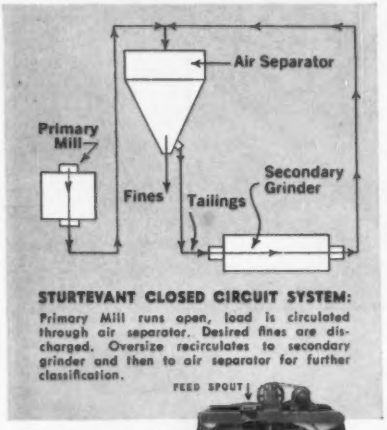
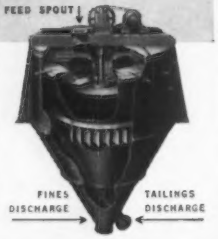


STURTEVANT CLOSED CIRCUIT SYSTEM:
Primary Mill runs open, load is circulated through air separator. Desired fines are discharged. Oversize recirculates to secondary grinder and then to air separator for further classification.



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Production capacity impossible in single-pass grinding results from using Sturtevant Air Separators in closed-circuit grinding systems. They are of proved advantage in all secondary reduction processes.

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Precise Classification; Circulates Loads of 800 tph

Sturtevant Air Separators circulate production loads of up to 800 tph. Simple adjustments make possible counter-action between air currents and centrifugal force to the point where a product of almost any desired fineness may be collected while coarser sizes are rejected.

A 16 FT. STURTEVANT, for example, took a feed rate of 800 tph, containing only a small percentage of desired fines, and delivered 30 tph 90% 200 mesh, recirculating the oversize through the grinding circuit. (In the cement industry, Sturtevant units deliver up to 60 tph raw cement fines, 40 tph finished cement fines.)

Nine models available, diameters from 3 to 18 ft. For more information, request Bulletin No. 087. (Bulletins also available on Micronizers, Blenders, Crushers, Grinders.) Write STURTEVANT MILL CO., 101 Clayton St., Boston, Mass.

Nevada *(Continued)*

will be held in Reno to approve terms of a loan which has been negotiated to finance construction of the mill, which will be the first of its kind in Nevada. Meanwhile work at the mine 10 miles west of Austin is proceeding steadily, and large tonnages of good ore will be available for milling when the mill is constructed.

Gold Placers-Nevada Co. is completing plans for extensive dredging operations in the Donald Placers area near Manhattan, in Nye County, according to R. W. Jerman, of Long Beach, Calif.

Dodge Construction Co. already has equipment and men at work in Pershing County, operating the firm's big iron mine in Coal Canyon southeast of Lovelock. Ore is hauled to Colado where it is loaded on S. P. cars near the new Eagle-Picher mill. Minerals Materials Corp. is also carrying on large iron ore mining operations in Coal Canyon and loading at the Colado site.

Nevada's percentage gain in gold output is outranking the rest of the country, according to the U. S. Bureau of Mines. The increase is credited to the Round Mountain Dredging Co. operations at Round Mountain, the U. S. Mining and Milling Corp. operation at Silver Peak which is handling gold ore from a wide area of Esmeralda and Nye County, and to Kennecott Copper Corp. operations in White Pine County, where by-products of gold and silver are important additions to copper values in the ore bodies. Nevada's gain in gold output was 58% during August, and activity in that field is increasing steadily, according to mining officials.

H. S. Thomas, Lovelock mining engineer, is operating an iron mining project 30 miles east of Lovelock and is shipping ore to domestic markets at Fontana and points in the northwest. Production of ore at the property has continued steadily for the last few years. On Nov. 3, Thomas was injured when trapped in the cab of an upset dump truck at the mine site, but he was expected to be back as active manager of his mining property soon after the first of the year. Ore from the Thomas mine is loaded at Woolsey.

NORTH CAROLINA

Appalachian Sulphides, Inc., is making plans to increase daily tonnage of copper ore from its Ore Knob mine in Ashe County, near West Jefferson, from 400 to 800 tpd by the beginning of 1959.

Sinking has reached 1,286 ft and has been completed for the time being but two drills now are in operation for extensions of the orebody horizontally along the vein.

The mine was first worked in 1855 and has been worked intermittently since. Appalachian Sulphides, a subsidiary of Nipissing Mining Co. of Canada, has set up a $3-million operation to develop the mine, hoping to have it into full production by January.

UTAH

Standard Uranium Corp. has expanded its recent Big Buck mine discoveries to more than $20-million worth of uranium ore in place, according to W. R. McCormick, Moab, Standard president.

The firm's reserves at the Big Indian district mine now stand at more than 608,000 tons of above average grade, low lime content ore, McCormick said.

"Several thousand dollars" damage was inflicted on the old mill and other properties of the Daly Judge mine at Park City, a property of United Park City Mines Co., as result of a fire Nov. 29, says Walter De LaMare, UPC mine superintendent.

Utah Minerals Co. has leased the 75 tpd flotation mill of Sun-Star Mining Co. in Salt Lake City and plans to re-run tailings from the Park City district.

Tom P. Costas, Park City, head of Utah Minerals, said that about 500,000 tons of lead-silver-zinc tailings from such old mines as the Daly West, Judge and the Silver King would be pushed through the mill "on a 100 tpd basis."

WASHINGTON

Bear Creek Uranium Co., Rhame, N. D., announced plans to continue shaft sinking operations in the Mount Spokane district through the winter season. Oscar Herem, mine supervisor for the firm, said that the shaft operations have been winterized at the development site.

So far the company has extended a 7x9 ft vertical shaft a distance of 94 ft.

Mr. Herem and "Duffy"

A 47-ft drift and a 60-ft crosscut have been extended from the shaft. The company now has about 200 tons of low grade ore stockpiled at the site. It has shipped 575 tons to the Dawn Mining company mill at Ford for processing. Officials hope to ship about 300 tons of ore a month to the mill.

Sherman Mining Co., Inc., of Omak, has sunk a shaft to 200 ft on the Brook Lode claim and drifted 150 ft. Channel assays have shown interesting results in silver, lead, zinc, gold, manganese and copper.

Sherman Mining is replacing some old equipment at the mine and has purchased the American Graphite ball mill, three miles north of Omak.

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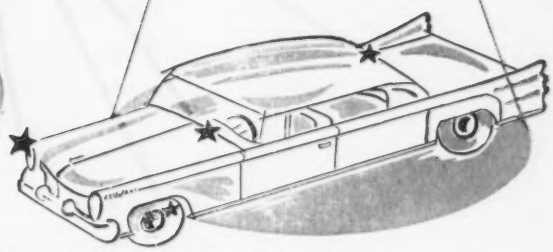

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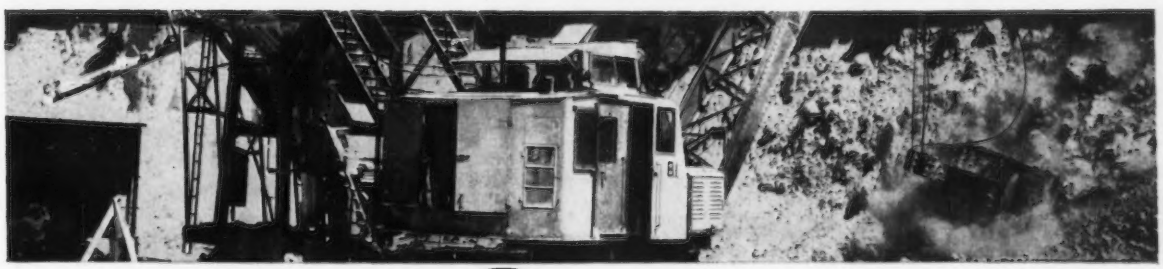

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IN CANADA

ONTARIO

A shaft deepening program, designed to open new levels for ore development, is under way on both the Quirke and Nordic uranium producing properties of Algom Uranium Mines in the Elliot Lake district. Three new production levels are being established at the Quirke with new depth at 1164 ft. Present ore production is being obtained from six levels to 864-ft depth. At the Nordic the shaft will be extended from the present bottom at 890 ft to 1325 ft. Four new levels will be provided to bring the total number of production levels to eight.

New Mylamaque Explorations has indicated by diamond drilling an estimated 45-million tons grading 28% iron on its Newcoro iron prospect near Kingston.

Higher iron ore shipments may be expected for Steep Rock Iron Mines from its property at Steep Rock Lake during the 1959 season. Steel output, which suffered sharp cutbacks early in 1958, has shown marked pick-up both in Canada and the U.S. In the 1958 season, which ended late in the fall, Steep Rock shipped approximately 1,154,000 long tons, compared with 2,348,538 tons in the previous year. Shipments for the last few months of the 1958 period were well above those earlier in the year.

Kirkland Minerals has commenced underground development at the Northstar Lake Mines copper-gold property in Davis Twp., some 25 miles east of Capreol. Shaft has been completed to 260-ft depth and lateral work is under way on the 125 and 250-ft levels.

QUEBEC

Alfried Krupp, Germany, and partner Cyrus T. Eaton, Cleveland, are going ahead with plans to explore and develop the Ungava ore deposits. An investment of over $200-million is contemplated. It is expected that production can be started in 1961 with 500,000 tons, increasing to 5-million tons annually by 1965. The ore will be shipped to Germany in "supercarriers" with capacity up to 45,000 tons. The first boat is being outfitted at the Krupp shipyard in Bremen, Germany.

Golden Age Mines has put a test mill of 150-200 tpd capacity into operation at its asbestos prospect, three miles north of Beauceville. The asbestos deposit has been indicated to contain some 15-million tons with grade to be established in the test mill. First material to be tested consists of core taken from four drill holes. Four 3-ft diameter holes were drilled for total footage of 280 ft. The core barrels, 10 ft long, pulled a section of 2.5-ft diameter weighing five tons.

A staking rush has developed momentum in an area located some 60 miles north of Chibougamau following discovery of copper-nickel mineralization. First into the area, Chibougamau Mining & Smelting and a syndicate, composed of Continental Mining Exploration, Canadian Northwest Mines and Oils, and Prudential Mining Co. of Canada, have snapped up a large number of claims.

Bateman Bay Mining Co. is opening the first of three indicated zones in a resumed underground program at its Chibougamau area copper property. This zone was encountered at the 68-ft mark in the crosscut being driven on the 250-ft level. It is planned to push through all three zones before turning off drifts along the individual zones. First channel samples in the zone averaged 5.73% copper over width of 6.9 ft and 5.91% across 5.0 ft. Values were also obtained in gold and silver.

Merrill Island Mining Corp. has recalculated ore reserves for its copper producing property in the Chibougamau area. Reserves are now shown at 732,706 tons grading 2.64% copper and 0.01 oz gold on the main property and 800,000 tons of proven ore averaging 2.15% copper and 0.029 oz gold on the leased area shared with Campbell Chibougamau. Indicated ore on this section is estimated at 467,000 tons grading 3.29% copper and 0.029 oz gold.

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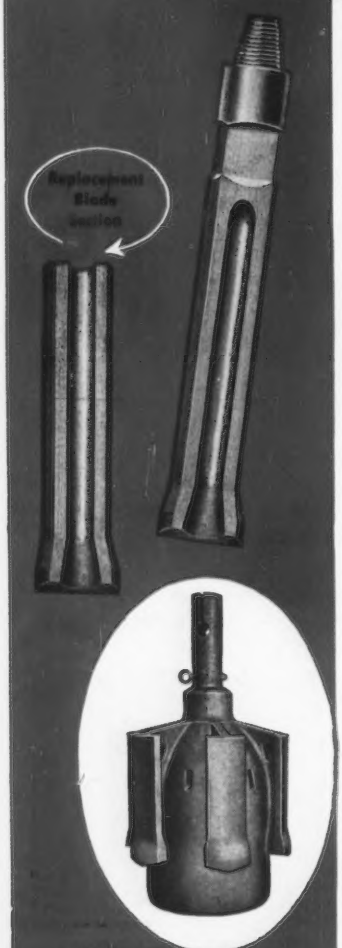

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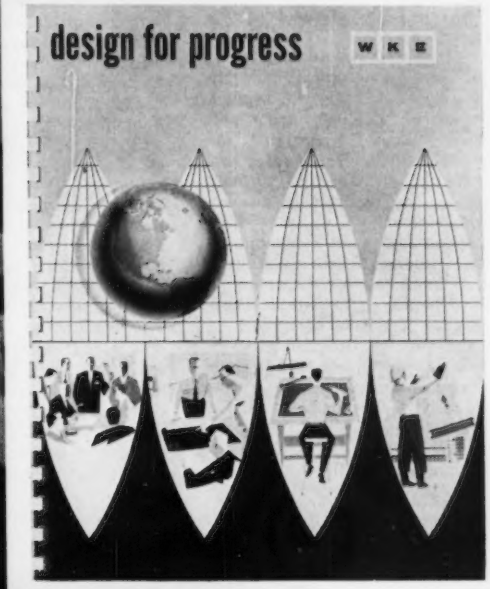

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Quebec (*Continued*)

The Mattagami district continues to attract attention with numerous companies engaged in preliminary exploration. Property deals have become commonplace as new companies move in to acquire ground. Activities have been highlighted by major discoveries, such as those of the Mattagami Syndicate, and of New Hosco and Orchan Mines, both of which are continuing intensive diamond drilling.

New companies in the area include Southern Union Oils, Northcal Oils, Daering Explorers, Consolidated Bellekeno Mines, Marchant Mining, Mattagami Explorers, Camflo Mattagami Mines, Newlund Mines and a score of others. Drilling is under way on the Southern Union Oils ground in the Grasset Lake section to follow up favorable indications obtained in geophysical surveys and preliminary prospecting. Drilling is also being carried out on the Camflo property to test a number of anomalies. Geophysical work and diamond drilling is also in progress or planned on a score of other properties.

Chibougamau Jaculet has decided to resume underground work in preparation for production at its property in the Chibougamau area. The shaft on the property goes to depth of 600 ft and in previous operations lateral work was carried out on the 300, 450, and 600-ft levels. It is planned to drive a raise from the 300-ft level to surface, following which stope preparation and underground development will get under way. The property should be ready for production when the mill at the adjoining Copper Rand is completed.

SASKATCHEWAN

A Toronto mining group, W. S. Kennedy Grubstake 1958, Ltd., has completed an agreement with the Saskatchewan government for a $400,000 mineral exploration program in a 6,000-square mile block of the William River region, immediately south of the Beaverlodge uranium mining country of far northern Saskatchewan. The block is in a sandstone belt.

Terms of the agreement as announced by provincial mineral resources minister J. H. Brockelbank call for the region to be closed to public staking until a preliminary survey has been completed by the Kennedy interests. On completion of this survey and within six months the Kennedy organization can earn exclusive prospecting rights in one-half of the original withdrawal area for further periods, providing specific work commitments are completed by the company.

MANITOBA

Central Manitoba Mines is to participate in financing an exploration program on the Agassiz Mines property, 3 miles north of Lynn Lake. Surface work indicated good values in gold and silver over widths of 3 to 6 ft. Diamond drilling will investigate possibilities at depth.

Nor-Acme Gold Mines reports it will become active in the search for a new property to replace the Howe Sound-Nor Acme operation at Snow Lake which ceased operations in July 1958. The company expects to receive substantial funds under an agreement with Howe Sound, based on the sale of the assets which include mill, equipment, buildings etc.

Sherritt Gordon Mines reports gross earnings for the third quarter of 1958 are higher than those of the second quarter with an operating profit amounting to $1,877,603 against $1,697,844 for the previous three months.

Operations at the Lynn Lake Mine continue at a normal rate. The downward extension of the 'B' orebody has been found at the 2,000 ft level of the Farley shaft where development work is now in progress. It is anticipated a large tonnage of ore will be developed in this lower extension of the 'B' orebody.

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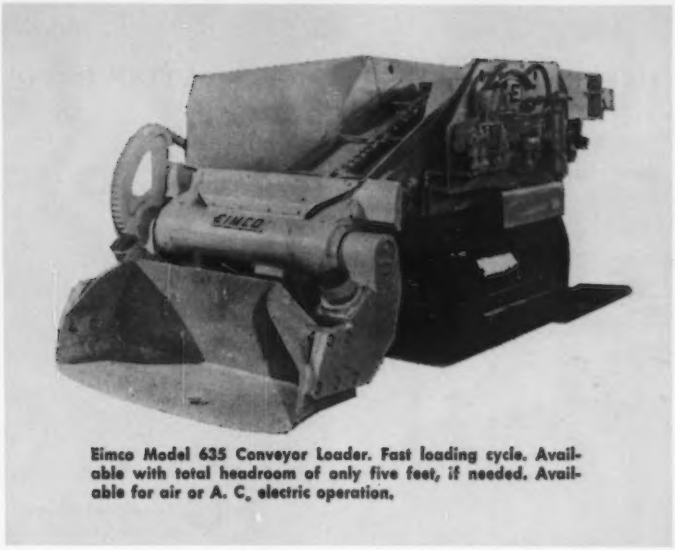
THE BIG



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Eimco Model 630 Tractor. Air or A. C. electric powered. Available with Dozer Blade Attachment; Excavator and Overhead Loader Unit and other special attachments as required.

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For high-production equipment that meets the needs of today and the future, let an Eimco sales engineer demonstrate the many unique advantages of Eimco designed and manufactured equipment. Contact the sales office nearest you or write The Eimco Corporation, P. O. Box 300, Salt Lake City 10, Utah.

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B-370

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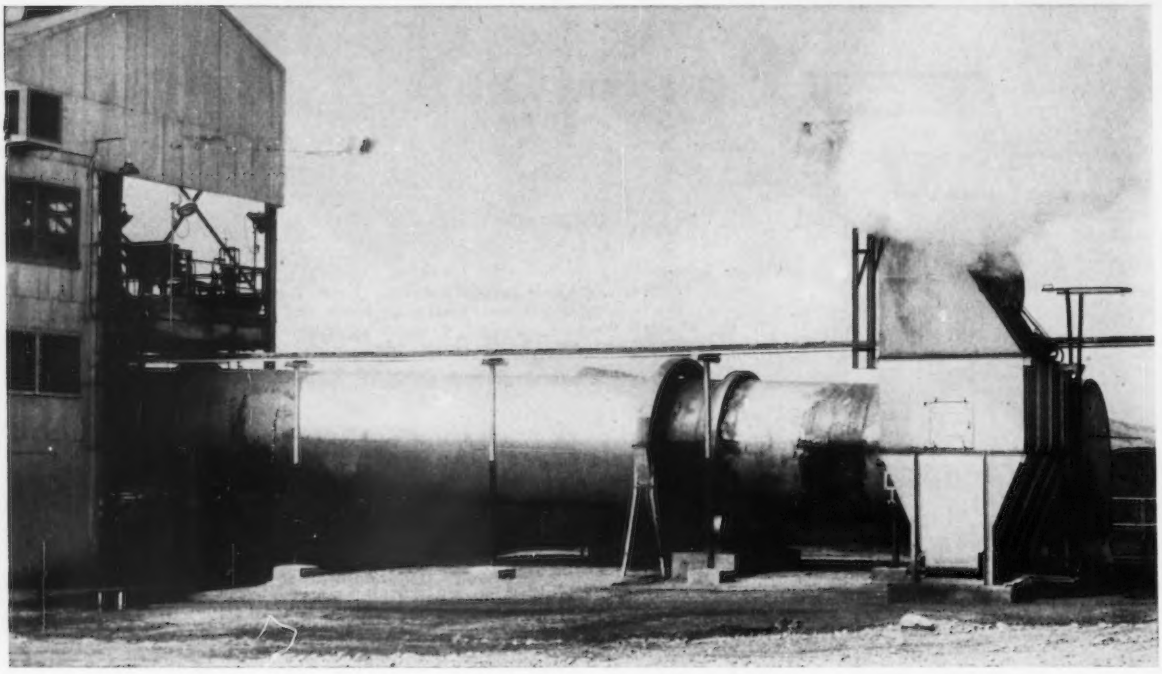
STANDARD HERSEY DRYERS



American Gilsonite's STANDARD cooler in operation at Grand Junction, Colorado.

GILSONITE TO GASOLINE... STANDARD STEEL SUPPLIES COKE COOLER FOR FIRST COMMERCIAL PLANT!

Standard Steel Corporation designed and built the rotary coke cooler now in operation at American Gilsonite's new refinery at Grand Junction, Colorado. This refinery, the first of its kind in the country to convert gilsonite into gasoline on a full scale commercial basis, uses an 8 ft. by 80 ft. coke cooler in the process. It's another cooler *Job-Engineered* by Standard Steel Corporation! A specially designed "floating inner jacket" protects the outer shell... and a water cooled feed and chute pre-cools the coke. Here is another fine name added to the long list of prominent, satisfied users of STANDARD STEEL rotary processing equipment.

Designers and Manufacturers of

ROTARY DRYERS
KILNS—COOLERS
CALCINERS
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...AND OTHER PROCESS EQUIPMENT

IF YOU HAVE A PROCESSING PROBLEM!

STANDARD STEEL welcomes the opportunity to discuss with you any problems you may have in drying, cooling or calcining. Our laboratory testing equipment determines beforehand the best equipment for your problem.

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(Division of Standard Steel Corporation)
ROTARY DRYERS • KILNS • COOLERS • ASPHALT PLANTS

"Talk up" increased production—greater safety...with these M-S-A COMMUNICATION SYSTEMS

M-S-A MINEPHONE

Dispatcher sends orders instantly and simultaneously to all motormen with this modern, underground two-way voice communication system. Motormen receive and reply while trips are in motion—keep haulage movements coordinated with production demands. This results in smoother, faster, and more continuous trip movements throughout the mine.

Messages clear tracks for outgoing loaded trips and incoming empties. This system puts an end to traffic tie-ups, errors and accidents; prevents excessive stop-and-start strain on equipment. Write for more detailed information.

• Dispatcher sends orders to motormen . . . routes right-of-way traffic . . . receives reports on positions and station conditions.

• "Jeep" operator requests instructions from dispatcher and maintenance shop for section assignment . . . speeds emergency repair.

M-S-A HOISTPHONE

For accurate, instant response between the hoisting engineer and cage, here's the voice communication system to install. Whatever the job—load leveling—shaft repairs—shaft inspection trips—passenger transportation—the M-S-A HoistPhone provides better safety and efficiency through dependable, continuous two-way voice communication at any level, and while the cage is in motion.

Requires no special training . . . simple to use . . . dependable in operation. Write for further information.

• The hoisting engineer is able to control all movements of the cage by communicating with cage rider over the M-S-A HoistPhone.

• Worker uses microphone in cage to tell the hoisting engineer where he wants to go. Loudspeaker mounted on top of cage.

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BRITISH COLUMBIA

F. A. McGonigle, vice-president of Howe Sound Co. of New York, said in Vancouver the company hopes to reopen its copper mine at Britannia which closed March 1.

"We are getting closer to the time we may be able to re-open the mine, but conditions still aren't quite good enough", he said. McGonigle noted that although the price of copper had improved, the duty of 1.7c per lb would have to be paid on all copper shipped to the U.S.

The mine is completely closed except for a small maintenance crew, and it would take three to four months to put it back into production. The company is waiting for a sustained increase in the price of copper before making a move. The fact the company refuses to sell homesites to former employees indicates the mine may be re-opened.

Consolidated Mining and Smelting reports zinc output is being maintained at about the 1957 level but lead will be down about 10%. Cominco is studying the U.S. quotas on lead and zinc imports but as only 28% of these went to U.S. during 1957, the restrictions are expected to have little effect. The company is studying pig iron production from tailings.

Noranda Explorations Ltd. has dropped its option on the 47-claim property of Highland Valley Mining Corp. Ltd., in the Gordon Lake group. Noranda has not yet given its reasons for ceasing work but, when results of work done by the major company are known, Highland Valley will be better able to plan future policy.

The company reduced its exploration activity in the past year due to softening of metal prices and difficulty in raising capital.

Craigmont Mines Ltd. has probable reserves of 13-million tons of 1.86% copper ore at its Highland Valley property, it was revealed in a progress report at the annual meeting of Placer Development Ltd., parent company of Canadian Exploration, which is major shareholder in Craigmont.

Giant Yellowknife Gold Mines Ltd. is installing new equipment which will increase the present 760-tons mill rate to 1,000 tpd by February, and enable the company to collect gold-bearing dust that is now lost to roasting procedure. The company's next cycle of development will start next year with the central shaft being deepened another 600 ft to the 2,000-ft level and three new levels established at 1600 ft, 1800 ft and 2,000 ft. From these levels lateral work to the extent of 10,000 feet will be carried out as well as diamond drilling. The program will require two years.

Blue Star Mines Ltd. has reclaimed 1100 feet of the old Matheson tunnel in its New Wellington mine by slashing and retimbering. New track, airline and ventilation pipe have been installed and preparation is under way for 500 feet of new drifting to reach the south and north veins. A strong vein has been cut at about 500 feet from the portal of the Matheson tunnel, and a 150-foot drift has revealed about 22 in. of ore with values of 27 oz silver per ton with 25% lead. Spring work is planned for the Star group.

IN LATIN AMERICA

CHILE

In October Chuquicamata broke all previous production records by reaching an output of nearly 53-million lb a month or a yearly rate of 636-million lb. Since the sulphide plant is being expanded by installing more rod and ball mills and the oxide plant has sufficient ore reserves to run many years yet, Chuquicamata may well be producing over 300,000 tons of copper by 1960, observers say.

The Paipote Copper Smelter in Atacama is likely to reach output of 22,000 tons of copper this year. It began in 1952 with 10,000 tons. Paipote has already increased, by 100%, its converting capac-

Got water? Get FLYGT

The B-150/200L FLYGT pump lifts *20 times its own weight* in water every minute! Its capacity is 3,000 GPM, yet it can be moved anywhere by panel truck and light crane (weight: 1,200 lbs.).

It is electric, fully submersible, requires no priming or installation. Like all FLYGT pumps, it needs practically no supervision or maintenance — can run dry without damage and takes a high proportion of solids without clogging.

B-150/200L data: 6" (high head) or 8" (high capacity) hose; 65 hp; 1,200 lbs; 3,000 GPM; max. head 220 ft.

There is a FLYGT pump for every job:

B-38L: 1½" hose; 1.8 hp; 79 lbs; 75 GPM; max. head 90 ft.

B-80L: 3" hose; 6 hp; 185 lbs; 330 GPM; max. head 170 ft.

B-80M: only 9" diameter; 3" hose; 6 hp; 140 lbs; 300 GPM; max. head 115 ft.

Higher heads with FLYGT pumps in tandem.

FLYGT

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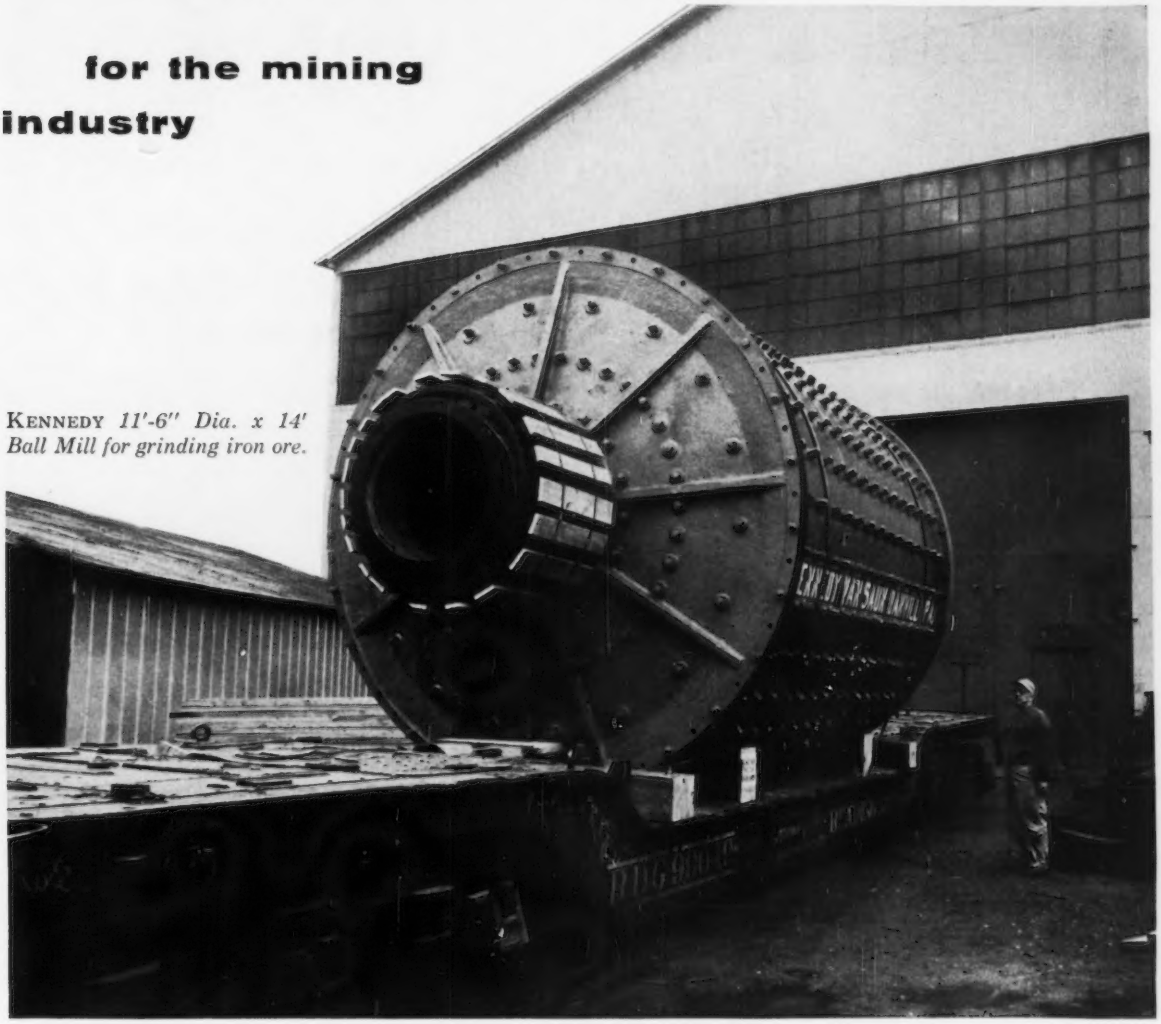

KENNEDY *11'-6" Dia. x 14' Ball Mill for grinding iron ore.*

Dependable operation in wet or dry grinding of material at low cost, with minimum maintenance—this is the reputation that KENNEDY Ball Mills enjoy.

You can profit from this reputation by specifying KENNEDY.

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operating on revolutionary nuclear-free-precession principle detects variations in the earth's magnetic field associated with magnetic ore bodies, subsurface faults and structural anomalies. Sensitivity of plus or minus 10 gammas is more than ample for the purpose. An extremely short (6 second) automatic reading interval permits rapid reconnaissance of large areas. Weight is only 16 pounds.

The Varian M-49 needs no leveling, calibration or orientation in azimuth. Its readings are precise even when the magnetometer is in motion — carried by a man on foot — mounted on horseback — or embarked in a boat. The sensing head is connected by cable and can be separated from the instrument body by several hundred feet—suspended by balloon—lowered over vertical cliffs.

To achieve these unique properties, Varian uses the proton free-precession principle which relies on an immutable nuclear constant (of the hydrogen atom). Other Varian magnetometers operating on this same principle are in use in magnetic observatories, airborne surveys, underwater surveys and in space vehicles.

FEATURES...

- Range 19,000 to 100,000 gammas.
- Direct reading meter in gammas; sensitivity of ± 10 gammas; no calibration required.
- Weighs only 16 pounds; all-transistor design; compact and rugged.
- Reading interval manually controlled or six-second automatic; usable stationary or in motion.
- Cable-connected sensing head separable by several hundred feet for multilevel surveys.
- Polarizing cells rechargeable by simple connection to automobile battery.

Write today for a full explanation of the Varian Magnetometer's principles, applications and equipment details.

VARIAN associates

INSTRUMENT DIVISION

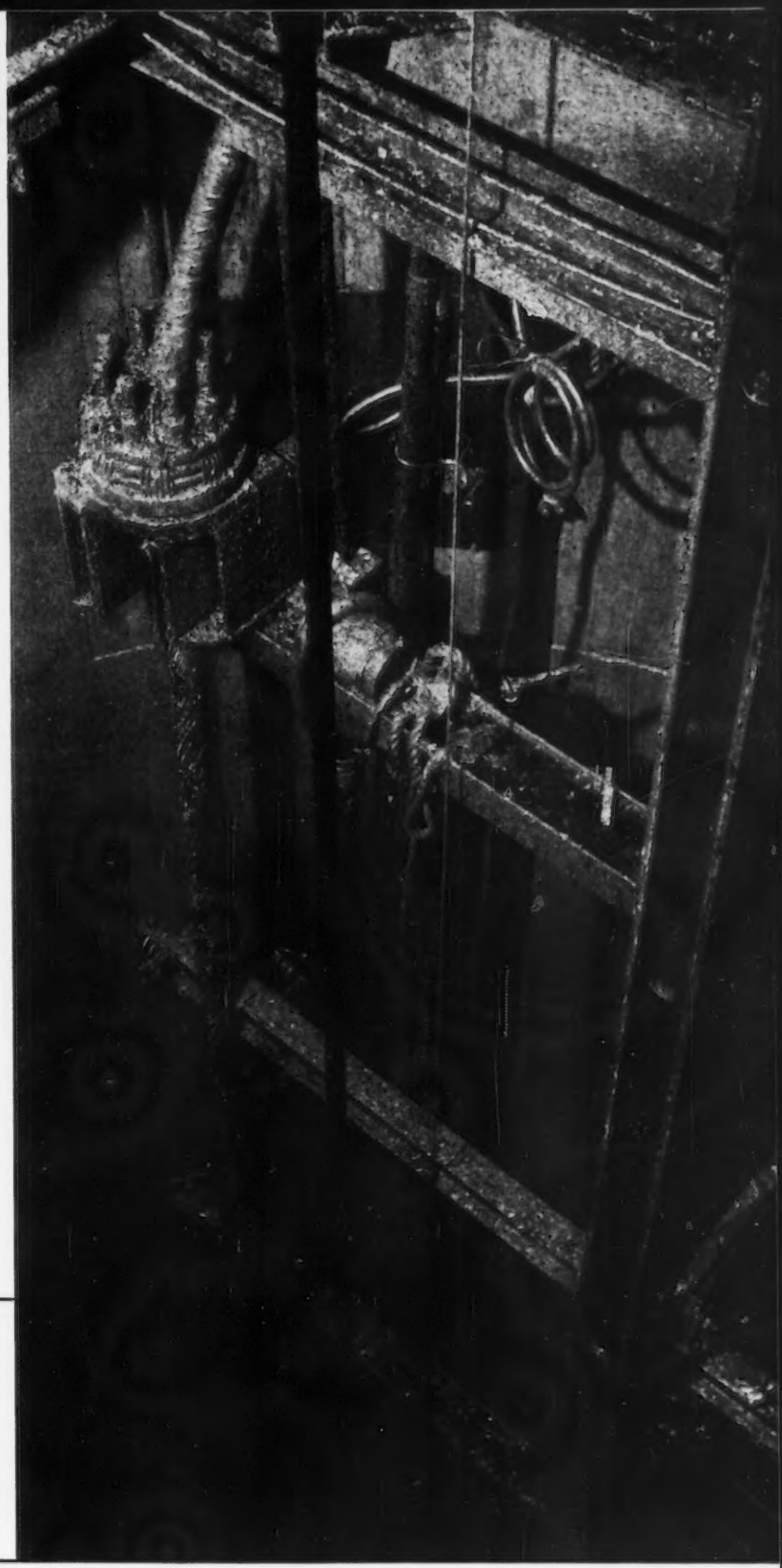
611 Hansen Way, Palo Alto, California

Continuous production hangs on this shaft cable

Falling in unbroken, near-record drops of **one-third of a mile** each, two Okolite 5kv, strip-insulated shaft cables carry every bit of power down two separate shafts to Intermountain Chemical Company's vast trona mine in Westvaco, Wyoming . . . to operate diggers, loaders, conveyors, hoists, lights and blowers. Production, profits—and **lives**—depend on the absolute reliability of these cables.

"The cables are continually drenched by condensing moisture," says Jack Wilson, Intermountain's Maintenance Supervisor. Great length of the suspension puts tremendous vertical pressure on the cable components. Considering their importance as well as the tremendous job of replacing them, Intermountain naturally wanted the most reliable, longest-lived cable they could get. Those were two good reasons for choosing an Okolite-insulated construction.

For **your** circuits that must not fail . . . be sure to call in Okonite. For information on choosing the right cables for your jobs . . . write for free Bulletin EM-1117, The Okonite Company, Passaic, New Jersey.



NEAR-RECORD CABLE DROPS

length: 1700 feet in each shaft
suspension: from a single clamp at shaft collar
construction: 3/c, 5kv, Okolite-insulated by strip process, with galvanized steel armor overall
weight: 19,000 lbs. each
tested: by 40,000 volts DC each
circuit and load: 4,160 volts from termination of Okolite-Okoprene aerial cables to power centers in mine

where there's electrical power . . . there's **OKONITE CABLE**

6217

Chile (*Continued*)

ity by installing a new 10x20 ft Peirce-Smith converter and will soon install a new 5000 kw steam turbine. Construction of a new 105x28 ft reverberatory to increase the smelting capacity of the plant from 150,000 to 300,000 metric tons of charge per year is planned.

A Chilean prospector, Sergio de los Rios, has located a large iron deposit in the upper Cordillera, Antofagasta province, at a place known as El Laco, 250 miles from the port of Antofagasta and only 9 miles away from the Argentine border. The deposit is said to contain "over 1-billion tons of high grade iron ore" and has been acquired by Cia. Minera Santa Fe controlled by the American firm of Isbrandtsen of New York. It has been estimated that $250-million will be required to get the mine into production. A new railroad and harbor, will have to be built.

Yawata Iron and Steel Co. of Japan has announced that it will soon start mining its high grade iron deposit of Las Adrianitas to the North of Copiapó which it has been drilling for nearly two years. 11-million tons have been proved.

The Mitsubishi group—Japan's industrial giant—announced a final plan, pending approval by the government, to develop two iron ore mines in the State of Atacama.

The six of 23 Mitsubishi affiliated companies—Mitsubishi Mining, Mitsubishi Trading, Mitsubishi Kaiun (Shipping), Mitsubishi Shipbuilding & Engineering, Mitsubishi Bank, and Tokyo Marine & Fire Insurance have got together since last October and set up two committees for transport of the Chilean iron ores and for establishment of a $555.555-capital new iron ore developing company.

MEXICO

The biggest news at the start of the new year for Mexican mining is the fact that the new government under President Adolfo Lopez Mateos (inaugurated in December) is planning to create a cabinet post called "Patrimonio Nacional" (National Patrimony) which will be the most powerful of all government posts under the president.

The new secretariat would have under its roof, Pemex (the government-run national oil monopoly) and a sub-secretary for mining and all national lands.

Trade rumors in Mexico City have it that Germany's Krupp is combining with Mexico's Nacional Financiera and the Comision Federal de Electricidad (Federal Electricity Commission) to make a survey of Mexico's coal, iron and power potential in the northwest with the idea of developing it into an iron and steel combine to use the coal and ore with some of the coal going into thermal power production. Krupp recently combined with a Mexican industrialist, Bruno Pagliai (head of Tamsa, a steel tube company), Siemens of Germany and Charles Allen Corp. (Wall Street investor who controls some mining and metals interests in the U.S.), to form a Mexican company called: "Intercontinental S.A."

A soda-ash refinery is to be established in Guadalajara. During the early half of 1958 a company authorized by the Government of Mexico was formed to exploit certain mineral deposits in the State of Sonora; the processing operation will be undertaken in Guadalajara. The principal product will be soda-ash, which Mexico is importing in substantial quantity.

ECUADOR

Three metals corporations—Koppers Co., Strategic Materials Corp. and Universal Mineral Resources Inc. (the latter owning lease-holdings in Ecuador)—believe they can produce carbon blooms and billets at around $40 a ton, utilizing the Strategic-Udy Process. This would be considerably under the cost using the more conventional methods.

Lester Renard, president of Universal Minerals, said that plans for erection of the steel mill will be announced early in the new year.

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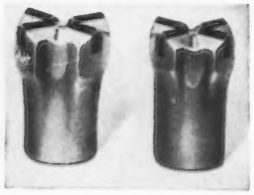
Brunner & Lay blast-hole drill accessories have always been made in a wide range of types and sizes, with job-fitted carbides, to meet exactly your needs. This means more footage per grind, with drill speeds up and footage costs down. For details, call our nearest plant. Brunner & Lay, Inc., 9300 King St., Franklin Park, Ill. *76 progressive years.* Plants & Warehouses: Philadelphia, Asheville, Birmingham, Dallas, Albuquerque, Denver, Los Angeles, Sacramento, Portland, Seattle, Lachine, P.Q.

Brunner & Lay 4-point Intra-Set affords easier starting—and following—with the use of smaller size bits. No attachments to lose, bind or stick. Only Brunner & Lay offer both 4-point and chisel types with bit and steel as one piece. Ask for Bulletin 1S756.

Carbon or alloy drill rods. Serviced and fabricated at our many plants. Ask for catalog #358 on your company letterhead, stating your position.



Widely used #400 and #200 carbide Rok-Bits for medium long hole drilling with light drifters and ⅞" hex. alloy Brunner & Lay sectional steel. Write for information on this, and other, money-saving applications.

Brunner & Lay taper-socket Rok-Bits. No threads to strip. Strong, power-saving union. Easily assembled and knocked-off. Save rod handling, reduce breakage. All tapers and popular sizes.

Brunner & Lay Products

CARBIDE ROK-BITS • INTRA-SET STEEL • DRILL RODS • COUPLINGS, ADAPTERS & EXTENSION STEEL

When you buy equipment that must earn money, it pays to buy the best. That is why thousands of the famous Model HO "PAYLOADER" tractor-shovels were purchased and why this new, improved Model H-90 will prove even more popular.

Full 9,000 lb. Carry Capacity

The Model H-90 has more Carry Capacity than comparable machines weighing as much as 3,000 lbs. more. Its Lifting Capacity is 15,000 lbs., but its *Carry Capacity* is 9,000 lbs., which means that you can use buckets up to 4 cu. yd. (SAE Rating) depending on the weights of materials to be handled. A breakout force of 21,000 lbs. — almost the weight of the machine — can be applied to the bucket cutting edge.

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You have a choice of four heavy-duty engines: a 125 hp Hercules or 134 hp I-H for gasoline; 122 hp Cummins or 126 hp GM Diesels.

Easy Operation, Long Life

Power-shift transmission with 3 speeds forward *and* reverse, torque-converter, twin-cylinder power-steer and 4-wheel power brakes assure fast, easy operation all day long. Power-transfer differentials and heavy-duty planetary final-drives provide high traction and axle reliability for all ground conditions. Sealed front wheel brakes prevent scoring and glazing. Large oil-bath air cleaners and cartridge-type oil filters protect the engine, hydraulic oil and transmission-torque converter oil.

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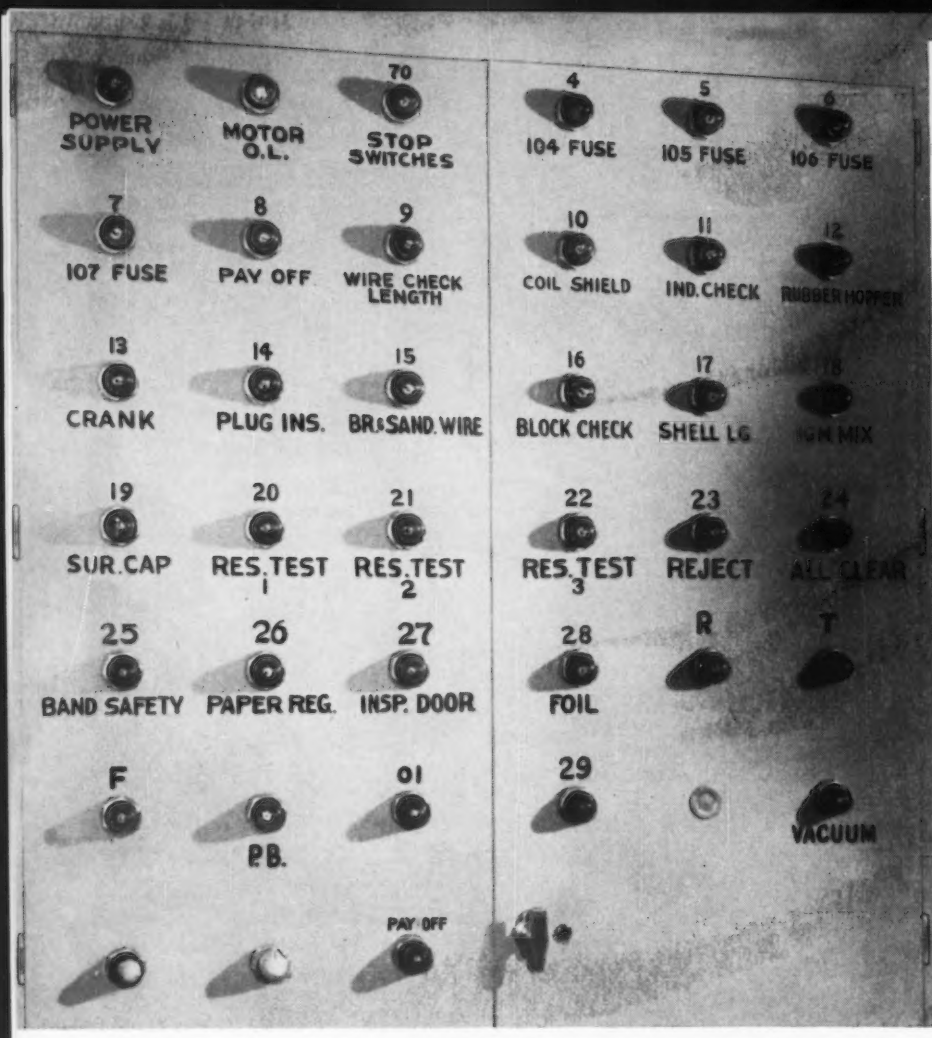

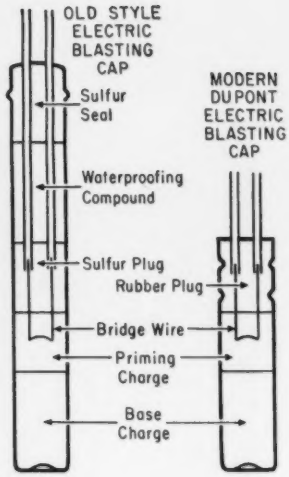

SEE THE DIFFERENCE—The one at the right is the **modern** DuPont cap. It's shorter, easier to prime, but has the same load.

THIS CONTROL PANEL guides the assembly of every DuPont electric blasting cap you buy. It's the electronic "front office" of the world's most modern **(fully automatic)** blasting cap assembly line.

No chance of human error...

In this electronic "headquarters" of the world's most modern blasting cap factory...means even more dependable, more uniform caps for you

Here's the latest example of DuPont leadership in the development of better, safer blasting caps... a revolutionary, new, fully automatic, electronically-controlled manufacturing process to eliminate the possibility of human error.

Every step in the process, from automatically loading the shell to applying the shielded shunt and paper band, is electronically controlled. And as each cap goes through the line, it is inspected and tested dozens of times—automatically rejected if it doesn't meet our rigid standards.

AND NOW CONSIDER ALL THESE OTHER DU PONT ADVANTAGES...

1. The synthetic rubber plug which eliminated the old-fashioned sulfur plug, waterproofing compound and sulfur seal, giving a waterproof cap with a much shorter shell, easier to prime.
2. The famous shielded shunt which shorts the leg wires and positively shields them from outside sources of electricity.
3. Plastic insulation, more efficient, easier to see, easier to strip.

You get all these benefits with every DuPont blasting cap you buy... both regular and delay... at *no increase in cost.*

SEND FOR THIS FREE BOOKLET! See for yourself how DuPont makes electric blasting caps in the world's most automatic blasting cap factory. Read how automatic testing at every stage of manufacture assures you of the highest, most uniform quality.

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LOUISVILLE CEMENT COMPANY, SPEED, INDIANA

Six 22-ton Euclid Rear-Dumps are hauling mortar stone, Portland cement stone and overburden at the Speed, Indiana, quarry of Louisville Cement Company. Working an 8 hour shift, three of these "Eucs" handle 400 tons per hour on hauls ranging from 1000 to 3000 feet. The wide bodies with struck capacity of 15 yards are loaded by a 4½ yd. shovel in four passes. Two other units are loaded by a 2½ yd. shovel. With loaded speeds up to 30 mph, they average 80 tons per hour on a 2 mile one-way haul. In addition, three of these "Eucs" work a second shift hauling overburden.

Louisville Cement Co., like hundreds of mine and quarry operators, has found that Euclid equipment moves more tons at lowest operating and maintenance cost. Dependable Euclid performance is the result of advanced engineering, rugged construction and almost 25 years experience with off-highway haulers.

To be sure you have the most economical hauling equipment, get a production and cost estimate from your Euclid dealer on the model best suited to your work — you'll find there are a lot of reasons why ***Euclids are your best investment.***

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FOR MOVING EARTH, ROCK, COAL AND ORE

UNDERGROUND
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YOU'LL CUT EXPLORATORY COSTS IN HALF WITH THESE DIAMOND CORE DRILLS
SUPER PIONEER
Here's a rugged compact light-weight drill you can take anywhere. The Super Pioneer eliminates guesswork by giving a true core sample to depths of 100' or more. Designed for one-man operation, drills at any angle in all formations. Gasoline-powered drill and pump weigh just 35 lbs. each.
Basic kit includes drill, pump, and accessories. Rods and bits additional.
$885.00
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SUPER SCOUT
This all-new air-powered one-man drill sets up and tears down in minutes, eliminating lengthy traffic tie-ups. Hand operated hydraulic feed supplies drilling pressure up to 1500 lbs. Anchor column provides drill support at any angle with or without back wall. Drills in any direction or at any angle to depths up to 100' with exceptionally high core recovery. Weighs just 85 lbs.!
Complete unit includes drill, hydraulic feed, anchor column, hoses, 50' of rods, core barrel, starting barrel, collar pipe, tools, and storage box.
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PERU

Official inauguration took place Nov. 17 of the 114-mile standard gage railway linking the concentrator at the Toquepala copper mine of the Southern Peru Copper Corp., at an elevation of 9,570 ft in the western Andes with the Port of Ilo in Department of Moquegua, Southern Peru, and the company smelter 12 miles north of the port.

Completion of the railways mark a major advance in the $230-million development program of the huge copper project which is now expected to enter into operation in the latter part of 1959.

A rich nitrate deposit has been reportedly discovered in the district of Balsas, Province of Leimebamba, Department of Amazonas, Northern Peru. The highway from the Pacific port of Pacasmayo, via Chilete and Cajamarca to the town of Balsas, on the east bank of the Marañon, runs through a part of the deposit, on which a 8,000 acre claim named "El Chato" has been filed by General Augusto Villacorta Alvarez, Eloy Burga Tejada, Richard León Jeanneau, Rafael Carranza and Guillermo Burga Tejada. Discovery of the deposit is said to have been due to the fact that inhabitants of Balsas have used substances from this area for years in the manufacture of skyrockets.

The deposit is contained in a mountain, extending for various kilometers along the Marañon, in which old Spanish gold workings have been discovered. Samples taken from the surface to a depth of several yards contain 40% of soluble products, with nitrate content ranging from 10 to 70% and with chlorides, sulphates, phosphates and iodates in commercial percentages. Quartz tailings in the old workings are reported to run from 2 to 5 gram of gold per ton. It is said that 10 tons of material from the deposit will produce one ton of nitrate, even in the poorer sections.

TRINIDAD

Caribbean Iron Mines, Ltd., recently registered in Trinidad, has announced plans to begin mining operations on a 2,700-acre concession in the Northern Range. The concession was obtained in 1953 by Samuel S. Douglas, a British Guiana-born prospector.

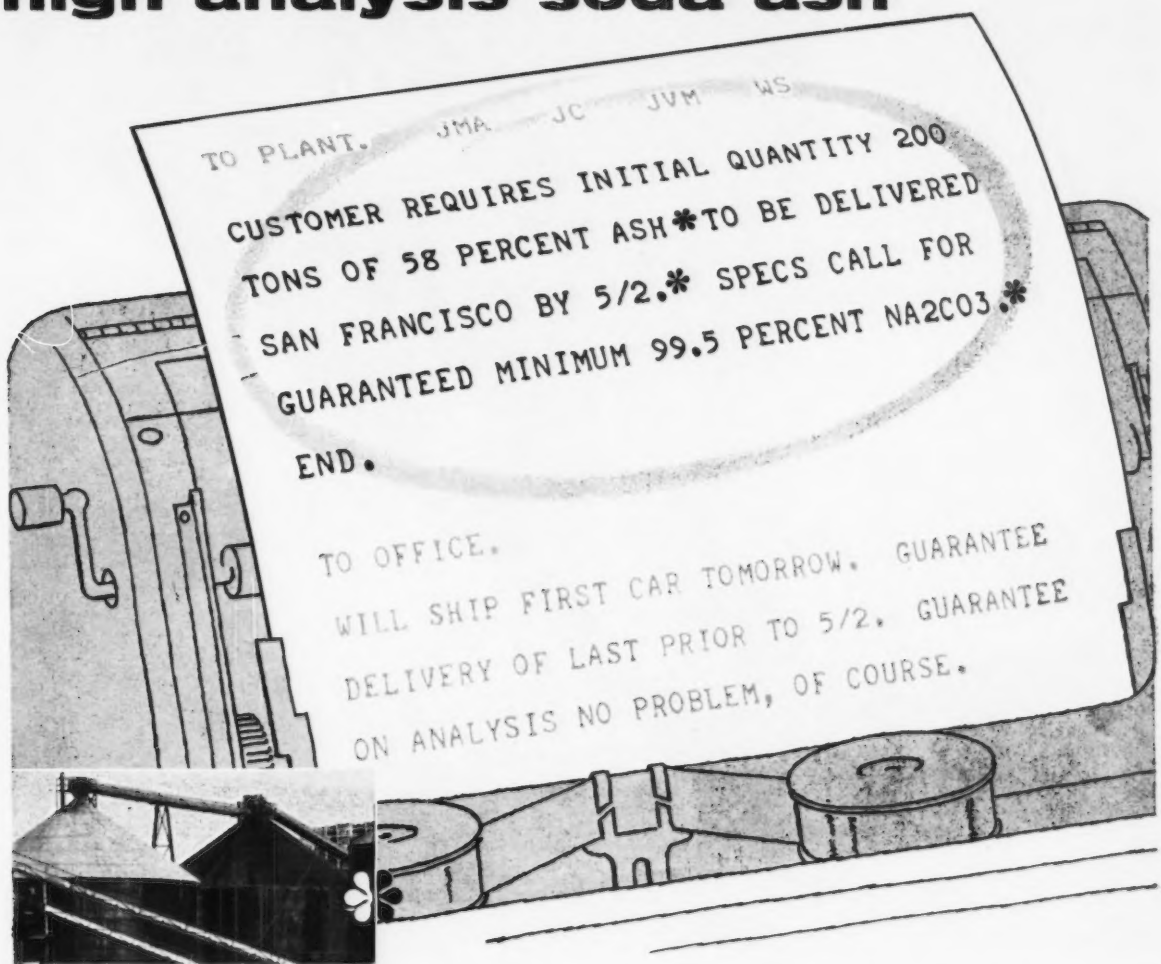
According to a press announcement, the concession contains about 20-million tons of ore—about 240,000 tons on the surface and the remainder just below. The news item also stated "that the iron ore content in some instances is as high as 85%."

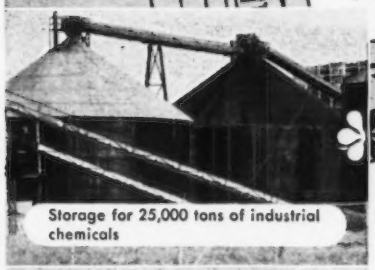
CUBA

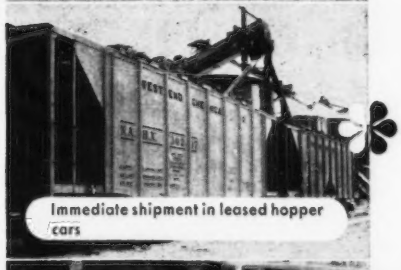
The name of Cuban American Nickel Co., a Freeport Sulphur Co. subsidiary, has been changed to Freeport Nickel Co., Charles A. Wight, Freeport Sulphur president, announced.

Freeport Nickel will operate a refinery

West End "fills the order" for high analysis soda ash


TO PLANT. JMA JC JVM WS
CUSTOMER REQUIRES INITIAL QUANTITY 200
TONS OF 58 PERCENT ASH*TO BE DELIVERED
SAN FRANCISCO BY 5/2.* SPECS CALL FOR
GUARANTEED MINIMUM 99.5 PERCENT NA2CO3.*
END.
TO OFFICE.
WILL SHIP FIRST CAR TOMORROW. GUARANTEE
DELIVERY OF LAST PRIOR TO 5/2. GUARANTEE
ON ANALYSIS NO PROBLEM, OF COURSE.


Storage for 25,000 tons of industrial chemicals


Immediate shipment in leased hopper cars

Constant control for uniformly high quality

Meeting service requirements to the letter and producing superior soda ash of consistently accurate particle size and chemical analysis are the essentials to which the West End organization is uniquely geared. A system of rapid communications linking our sales office in Oakland with our production, technical and shipping departments at the desert plant site permits each department head to have a complete understanding of the customer's individual requirements and to make firm commitments or provide the desired information promptly.

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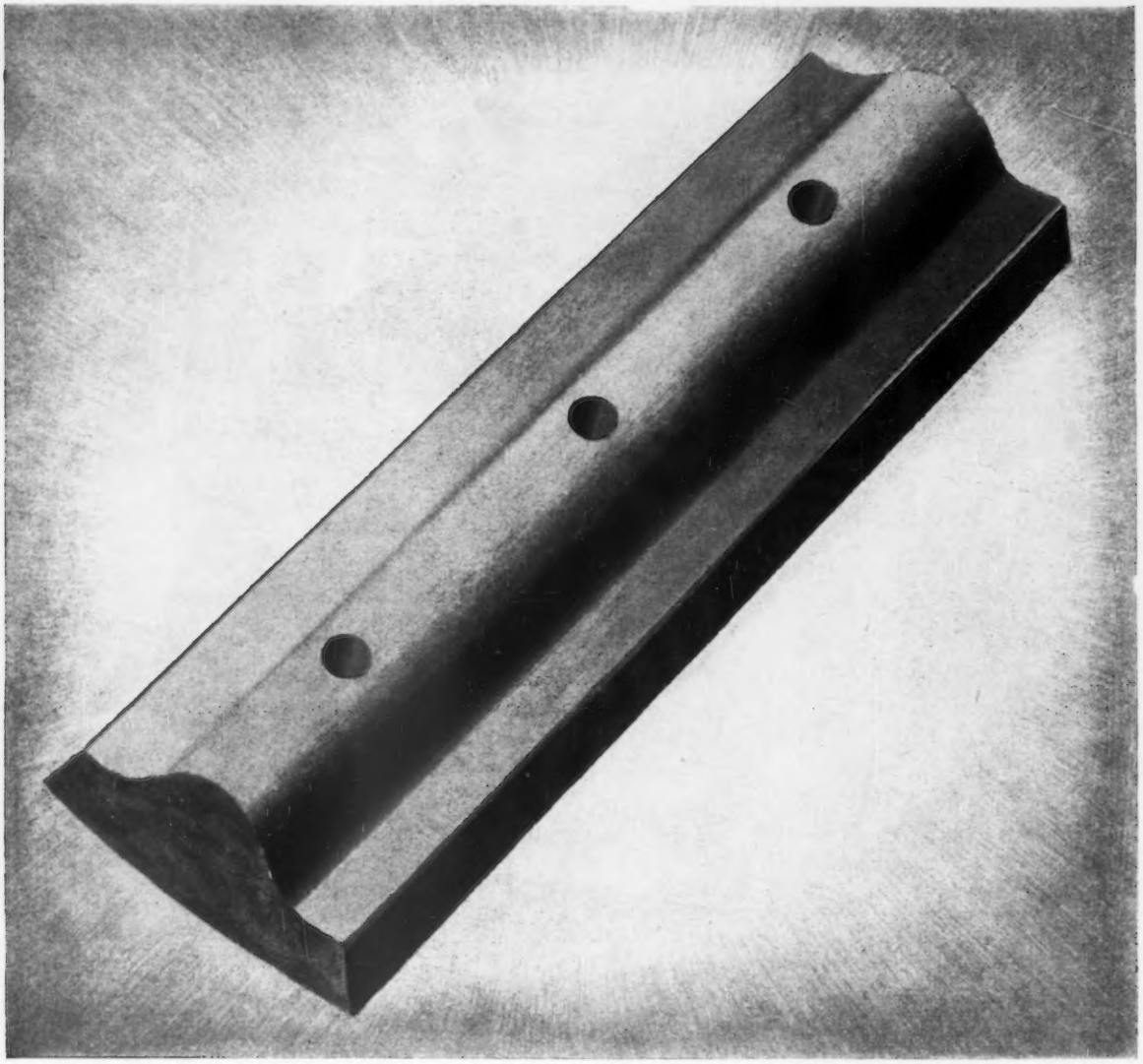

LINER DIMENSIONS: WIDTH 18-3/4", LENGTH 36", BASE THICKNESS 3", WAVE 3-1/2"

NI-HARD DOUBLES MILL LINER LIFE

OVER 2,200,000 TONS OF TACONITE GROUND WITH RUGGED, ABRASION RESISTING NI-HARD (ABK METAL) LINERS PRODUCED BY THE AMERICAN BRAKE SHOE COMPANY

Even hard taconite is no problem with Ni-Hard* nickel-chromium cast iron! That's why one plant – using chilled Ni-Hard (ABK Metal**) liners – was able to achieve double the life of any other liner material or design. The Ni-Hard liners ground over 2,200,000 tons of taconite ore in 10½'x16' rod mills with 85 tons of 4" rods rotating at 14.7 rpm.

Ni-Hard can mean important savings for you, too. Authorized producers throughout the country are ready to supply liner segments for your mills. Write Inco for the name and address of the one nearest you.

*Registered trademark, The International Nickel Company, Inc.
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67 Wall Street INCO New York 5, N. Y.

NI-HARD

NICKEL MAKES CASTINGS PERFORM BETTER LONGER

TRACTION...

unequaled in any other truck

Six-wheel drive plus exclusive Balanced Bogie with Power Divider endow this Mack heavy-duty dumper with matchless traction over any surface that will support a truck.

Macks get in—and out—of spots where other trucks bog down. And especially this big, 65,000-lb. GVW Mack heavy-duty dumper—the Model B-8136SX.

Only Mack combines the six-wheel-drive feature with exclusive Balanced Bogie with Power Divider—the four-wheel, rear-axle drive that transmits the most power to the wheels having greatest traction.

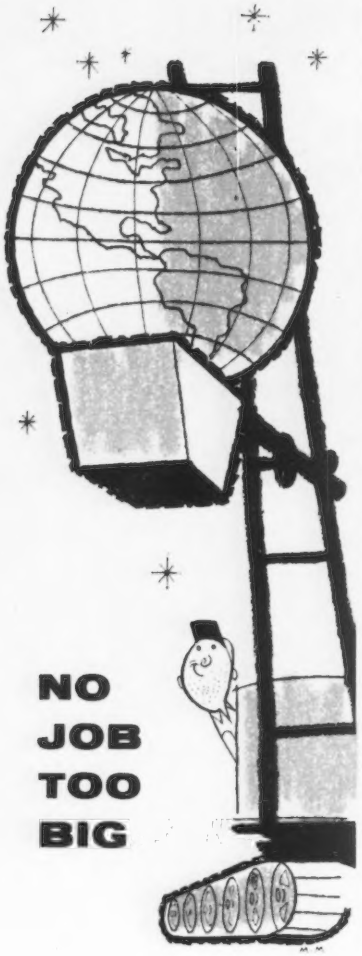
Exclusive Mack front driving axle transmits power to the wheels through a single-reduction carrier and two pairs of spiral-bevel gears at the steering knuckles. Maximum ground clearance is thus attained and, being fully enclosed, the complete driving and steering mechanism is protected from dirt and water.

Exclusive Mack Thermodyne® diesel engine delivers up to 205 hp at 2100 rpm for long life and outstanding economy.

Exclusive Mack Duplex 10-speed heavy-duty transmission with integral transfer case turns engine power into steady pulling ability for year after year of dependable, repair-free life.

If next-to-impossible going is slowing down your operations, get full facts on this rugged, sure-footed Mack for arduous on-and-off highway service. Mack Trucks, Inc., Plainfield, New Jersey. In Canada: Mack Trucks of Canada, Ltd.

MACK
FIRST NAME FOR
TRUCKS



All kidding aside...
we have the men, the
equipment and the know-how
to handle any job.
Selective open pit mining and
volume earth moving—
over 350 million tons on jobs
everywhere—has long been
a specialty with Isbell.
We've handled copper, gold,
sulphur, manganese, tungsten,
uranium, non-metallics,
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Cuba (*Continued*)

for nickel and cobalt at Port Nickel, La., on the Mississippi River below New Orleans. To supply the refinery, Freeport Nickel's subsidiary, Moa Bay Mining Co., will mine and concentrate ores at Moa Bay in Cuba's Oriente Province.

Beginning in the summer of 1959, Freeport Nickel Co. will produce 50-million lb of nickel metal and 4.4-million lb of cobalt metal annually.

BRITISH GUIANA

Roraima Mining Co. of Canada has been given the exclusive mining concession to prospect for gold and diamonds in the Echilebar River area of British Guiana near the Brazilian and Venezuelan borders, a report from Georgetown, dated Nov. 14, said.

IN AUSTRALIA

The South Alligator Uranium N.L. treatment plant will come into operation in August 1959 and is expected to produce uranium oxide worth over $1-million a year. Deliveries to the U.K. Atomic Energy Authority will commence around September 1959 and will last until early 1963.

The mineral sands plant of Westralian Oil Ltd. is expected to start production in March 1959. Demand for Australian ilmenite has weakened but low costs of production should enable producers to carry on. Another Western Australian producer, Western Titanium N.L. almost doubled its output of ilmenite in the latest quarter when ilmenite produced was 13,150(6800) tons. Zircon production is 1370(1285) tons, monazite 91 (128) tons, rutile 117(135) tons and leucoxene 88(65) tons.

Mt. Isa Mine's copper smelter is increasing its output with practically no addition to plant, and production of 1,000 tons of blister a week is expected in the near future. In the lead smelter the conversion of D&L machines to new pallets is continuing. In the furnace a new 100-ton drossing kettle is being constructed.

IN THE PHILIPPINES

Underground development work at the Acupan mine of Benguet Consolidated has proved new ore extending over 768 ft, averaging substantially better than average mine run, assaying $9.90 per ton across 5½ ft. In general the possibilities of developing new ore on the Hartwell section on the 2,000 ft level are regarded as good. In the Antamok mine, development has exposed new ore for 750 ft averaging $8.34 per ton across 3 ft. Surprisingly good results are reported from diamond drilling to explore downward extensions of major ore shoots.

Toledo mine of Atlas Consolidated increased its production in October to 3,955,500 lb copper from milling 344,000 tons of 0.69% copper. The value of the production showed an increase resulting from the higher price obtained for the metal, and approximated $1,175,000. In October the value was based on 29.8c per lb for copper, contrasted with 25.5c in September.

According to the Philippine Bureau of Mines, there were 30 active mining companies in production during the 1957-8 fiscal year, compared with 33 in the previous year. These included eight lode gold mines, four chromite, six copper, five iron, six manganese, and one quicksilver. By-product gold was obtained from three of the coppers, and Surigao Consolidated, a gold producer, obtained lead as a by-product. The mining industry is estimated to have employed 33,500 men, and earned at least $73-million for the government in foreign exchange. Taxes, royalties, and fees for the government amounted to nearly $6-million.

October production as reported from other mines include Surigao Consolidated gold valued at $254,000, Consolidated Mines (chromite), $1,141,000, Samar Mining Co. (copper, gold) $117,000.

Lepanto Consolidated milled 39,000 tons of ore in October, averaging 3.38% copper and 0.127 oz gold per ton, producing nearly 2.5-million lb copper and 3703 oz gold.

Estimates of nickel-iron ore on Nonoc Island, off Mindanao, now place the nickel reserve at 143-million tons, against an initial estimate of 38-million tons. Larger reserves are reported on nearby Nagat Island. Bids for developing the deposits may be opened before the end of the year. It is estimated initial investment for developing the deposits would exceed $45-million.

According to Charles A. Mitke, president of Manila Mining Co., prospectors have uncovered favorable gold indications on the company's property in Mindanao. On the copper section, engineers have estimated that over 4-million tons of 1.17% ore have been indicated. Diamond drilling will be continued.

IN AFRICA

According to an official statement, the consulting engineers believe that the mining problems at the flooded Bancroft copper mine in Northern Rhodesia have been largely overcome. Intensive pumping and tapping of underground sources of water have lowered the water table appreciably. Lateral development has been started on several levels at No. 1 shaft so as to expose the ore over a wide area.

Bancroft will resume operations in April, according to official statement. The mine closed in March 1958.

Other TL-20 and TL-16 features include:

HYDRAULIC TORQUE CONVERTER DRIVE • TIP-BACK BUCKET • POWER STEERING • 4-WHEEL DRIVE • 4-WHEEL POWER BRAKES • "HI-TRACTION" DIFFERENTIALS • STRONG, PIN-CONNECTED PLANETARY AXLES • 4-WAY ADJUSTABLE SEAT • REAR-AXLE DISCONNECT • EXTRA STABILITY • "BUILT-TO-TAKE-IT" CONSTRUCTION.

TL-20 TRACTOLOADER® 2 cu yd • 104 diesel hp • Weight: 22,100 lb

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Loader Operation Simplified by Tractomotive... Result: Increased Production

Here you see the only transmission shift lever that is necessary on the TL-20 and TL-16 TRACTOLOADERS.

With this single lever, your operator has full control of the full power-shift transmission. He can shift into and out of any gear "on the go"— forward or reverse. There is no speed range lever, or any other shift lever, to slow him up. And this single-lever control is EXCLUSIVE WITH TRACTOMOTIVE.

Because your operator's work is simplified . . . your production is sure to be higher. Let a demonstration convince you. See your Allis-Chalmers construction machinery dealer.

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THERE IS A FAST-WORKING TRACTO-LOADER® TO FIT EVERY JOB — two and four-wheel drive.

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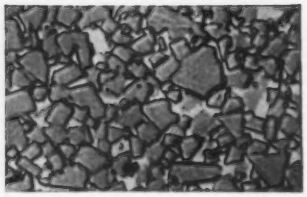
Longer bit life— with *new* Sandvik Coromant Bits



Sandvik Coromant Tungsten Carbide (Microphoto) Uniformity of size, even distribution of grain are marked. Free from porosity and impurities —therefore stronger, longer-lived.

Low quality Tungsten Carbide (Microphoto) Black marks are contaminations caused by deficient production control. They weaken the carbide, reduce its working life.

NEXT time you buy bits, specify Sandvik Coromant because they give more footage per bit, lower drilling costs. Here's why:

1 Only first-quality tungsten carbide is used —as shown in the microphotos above. This means less wear, longer life and a better job.

2 The bodies are precision-made of high quality alloy steel—tough enough to take the strain throughout the extra-long bit life.

3 The bigger Sandvik Coromant bits are all of X-design, which prevents rifling. No wonder Sandvik Coromant inserts are the most widely used in the world, drilling more than one billion feet every year.

SANDVIK COROMANT bits are supplied through Atlas Copco, the world's largest manufacturer of rock drills, who also supply Sandvik Coromant integral steels — the most widely used in the world — and Sandvik Coromant extension steel equipment.

Sandvik Coromant Detachable Bits are Available in the following Thread Sizes and Bit Diameters

Type	Thread	Available Diameters, in Inches															
		1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½	2¾	3	3½	4	4½	5
SHOULDER	TAPER	x	x	x	x													
	F		x	x														
	113		x															
	H			x	x	x	x	x		x								
	115			x	x													
	D						x	x	x	x	x	x	x	x				
	K													x	x	x	x	
BOTTOMING	1" Rope				x	x	x	x		x								
	1¼" Rope						x	x	x	x		x		x				
	400						x	x		x		x						
	1½" Rope											x	x	x	x	x		
	600											x	x	x	x			
	700													x	x			
	J7.5															x	x	
	2" Rope														x	x	x	x
	1000																x	

Write or phone today for further details to either of the addresses below:

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58 NORDBERG GRINDING MILLS in Ore Concentration Plant

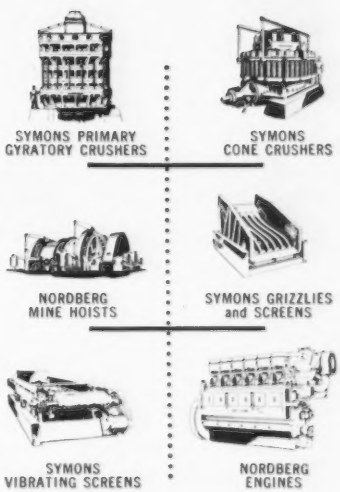
. . . largest iron ore mill installation under one roof in the world

Here, stretching about a quarter of a mile, are 27 Nordberg Rod Mills and 27 Nordberg Ball Mills in a concentrator building up in the Lake Superior Iron Range of Minnesota. The 54—10 foot diameter Nordberg mills reduce hard, abrasive Taconite Iron Ore to the fineness of flour. Four additional Nordberg mills serve as reserve replacement units.

This is but one example of the way in which Nordberg Grinding Mills, in sizes from 6 to 13 feet in diameter and up to 50 feet in length, are successfully serving the ore, mineral, cement and chemical processing industries of the world.

Years of specialized experience in the design, manufacture and installation of process machinery assure you that you can count on Nordberg, its machinery and "know how" to add efficiency and economy to *your* processing operations. For complete details, write for the Nordberg Grinding Mill Bulletin 232.

NORDBERG MFG. CO., Milwaukee 1, Wis.



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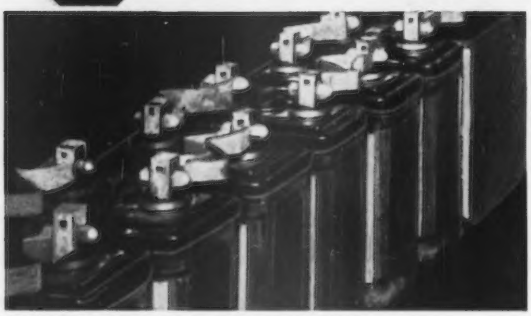
GM158

STOP **ARCING . . . CORROSION**



WITH DOW CORNING

SILICONE COMPOUND

Dow Corning 3 Compound helps eliminate power failures by providing a more durable seal against water, moisture, mine dust, alkalis, acids or corrosive fumes.

Use this grease-like silicone dielectric as a sealing agent in cable connectors and disconnect switches to prevent shorts and arcs. A light coating keeps lamp bulb bases, fuse cartridge clips and battery terminals corrosion-free. 3 Compound protects plastics, rubber, fabrics and metals. It's serviceable from —40 to 400 F.

WRITE TODAY for Free Sample and full information on how you can keep your electrical system at peak efficiency with minimum maintenance. Address Dept. 7113.

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Dow Corning CORPORATION
MIDLAND, MICHIGAN

Wherever Ore Moves, SCOOT-CRETE

Ore Carriers Move It • FASTER • EASIER • AT LOWER COST

SCOOT-CRETE CD-4, shown being loaded in mine, will carry up to 10 tons payload. Model CD-3N has 5-ton payload. Note driver's side-mounted position for maximum vision and efficiency, forward and rear.

On the Western Slope, on the Colorado Plateau, SCOOT-CRETE does the job. No rails needed, no ties, no cars, no independent power source. Diesel-powered for operation inside the mine, SCOOT-CRETE carriers are rugged for around-the-clock service, carry up to 10 tons at speeds to 15 mph, climb grades up to 18%. All CD models approved by U.S. Bureau of Mines for underground mining.

Units available from 3,000 lb. to 10-ton capacity. Write for specifications and literature. See your Dealer.

GETMAN BROTHERS SOUTH HAVEN, MICHIGAN

PERSONALS

A. P. Morris, general manager of the Ray Mines Div., Kennecott Copper Corp., was re-elected chairman of the Arizona Section, AIME, during the recent statewide meeting at Tucson.

Morris

Other top officers re - elected from 1958 to serve through 1959 include: **W. C. Lawson,** Douglas, first vice-chairman; **T. A. Snedden,** Tucson, second vice-chairman and **C. L. Hoyt,** Ray, secretary-treasurer. Lawson is vice-president and general manager, Western Operation of Phelps-Dodge Corp; Snedden is manager, western mining department, American Smelting & Refining Co.; and Hoyt is administrative assistant to the general manager, Ray Mines Div.

Dr. Ian Campbell, executive officer of the Division of Geological Sciences at California Institute of Technology, has been named chief of the California Division of Mines.

Campbell

He succeeds **Dr. Olaf P. Jenkins,** who retired last March. Acting chief during the interim was **Dr. Gordon B. Oakeshott,** who will now return to his former post as deputy chief.

Dr. Campbell leaves Cal Tech after 27 years of service. He started as an assistant professor of petrology and became executive officer of the Geological Sciences Div. in 1952.

International Minerals & Chemical Corp. announced that **H. Turner Loehr** had become director of engineering and **Lawrence A. Roe,** director of development, at its new research, engineering and development division. **Walter Lincoln Hardy** will be manager of chemical research.

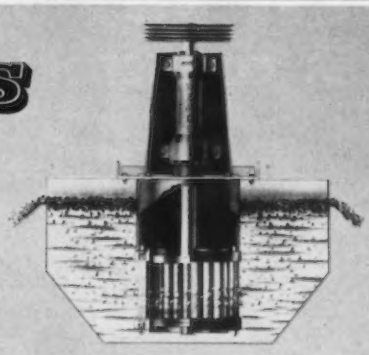
Directors of other departments in the new division are **Dr. M. B. Gillis,** research, and **Dr. F. C. Kruger,** mining and exploration.

Alden J. Teske has resigned as editor of **The Wallace Miner** to join the staff of the Idaho Mining Association. He has been editor of the Wallace mining newspaper since 1949. At his new post, Mr. Teske will be working closely with **Harry W. Marsh,** executive secretary.

Grand Junction Geological Society officers for 1959 include: **Robert H. Sayre, Jr.,** president; **Raymond C. Robeck,** vice president; **Philip Donnerstag,** secretary; **Don R. Hill,** treasurer; **Richard J. Frost,** councilman (petroleum); **Robert H. Toole,** councilman (government).

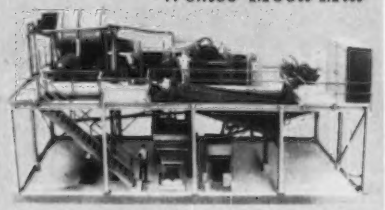
PRODUCERS

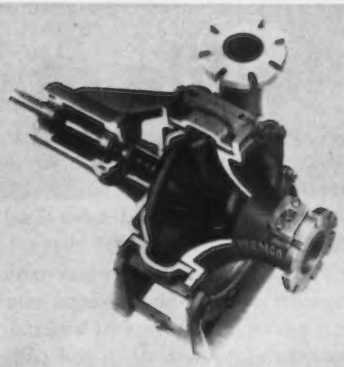
in the world of **Coal**



Wemco Fagergren Flotation Machine

Wemco Mobil-Mill





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. . . and other complete equipment
and services
for the Coal Industry

It's a combination geared to the progress of the coal industry: machines developed for more profitable high-grade production; skills paving the way for continuing improvements in application and results. Today — and in the future — depend on the men of Wemco to turn a problem into a profitable operation; look to Wemco equipment for top performance. Your questions will be answered promptly and positively — whatever the operation.

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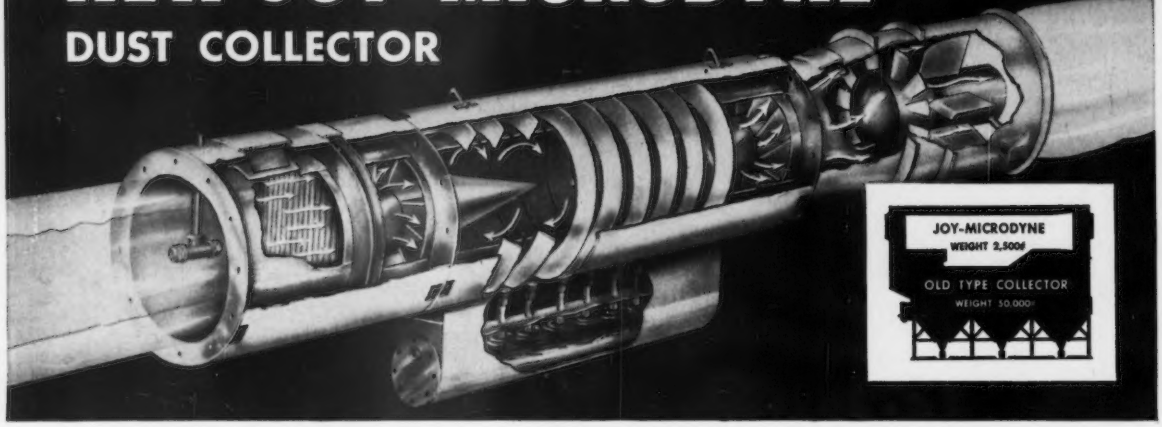
NEW PROVED JOY-MICRODYNE
DUST COLLECTOR



Profile of a Problem Solver

Here is an in-duct "educated pipe" that laughs at space, weight and water limitations as it collects over 99% of dust 5 microns and larger; 92% of 2-micron dust, and substantial amounts of smaller dust.

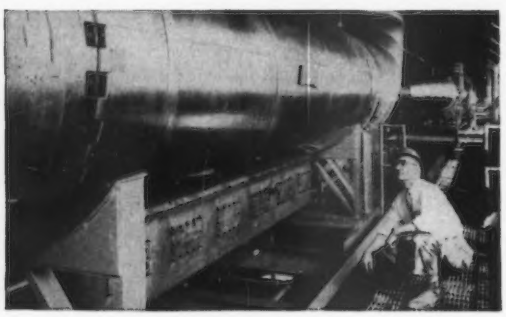
Particles enter through water-saturated air, slam against a water-film-covered impingement element, encase themselves in water droplets as they pass through, then whirl and collect on the sides of the middle section, to finally drain into a sump. Cleaned air is straightened and thrust on its way by an integral Joy Axivane Fan.

SAVES SPACE—Installs as an integral section of duct-work; requires only 1/10 to 1/20 the space of conventional units. 2500 cfm unit is 10 feet long; 1.5 feet in diameter.

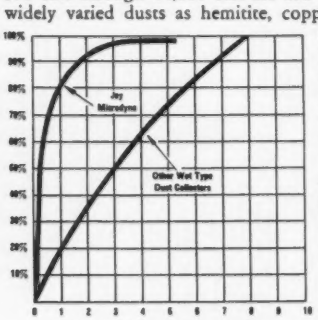
SAVES WEIGHT—Even the largest unit—64,000 cfm, 5 feet in diameter, 32 feet long—weighs only 6,500 pounds . . . or 1/5 the weight of conventional collectors. 2,500 cfm unit weighs only 325 pounds.

SAVES WATER—The largest Joy collector requires only 48 GPM flow—much less than comparable wet collectors. Add a Delpark Filter (Sold by Joy) and water can be recirculated to recover valuable dusts. The filter also reduces water borne solids to give a dependable, clear water supply from a dirty water source.

SUCCESSFUL INSTALLATIONS—Joy collectors from 500 cfm through 64,000 cfm are *now in use* collecting such widely varied dusts as hemitite, copper and uranium ores, coal, quartz, limestone, phosphate, stainless steel and titanium carbide grindings. For answer to your dust collecting problems, write, wire or call: ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** *In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*



This 48,000 cfm installation shows compact assembly and space economy of in-duct placement.

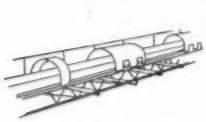


Performance graph of actual installation shows efficiency of the Joy-Microdyne Dust Collector. (A micron is 1/25,000 inch)

WSW I 7002-231

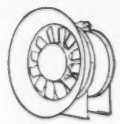
WRITE FOR FREE BULLETIN 231-4

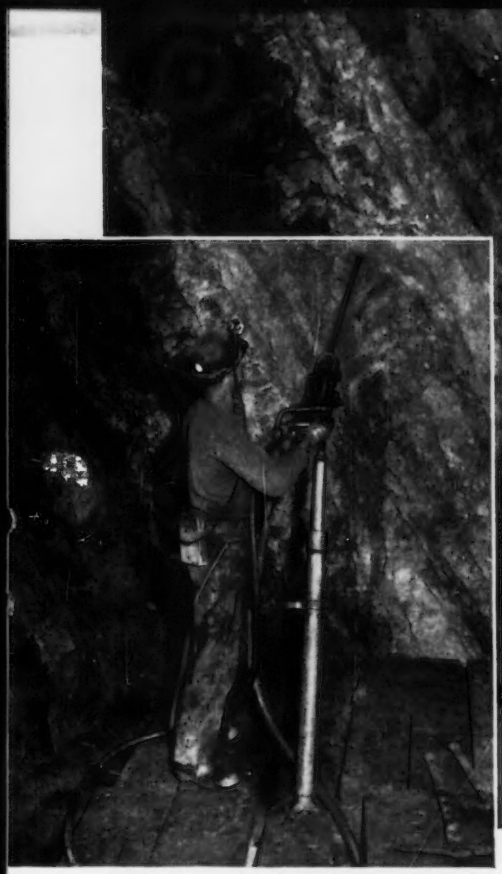
JOY . . . EQUIPMENT FOR INDUSTRIAL PLANTS . . . FOR ALL INDUSTRY


Conveyors

Industrial Compressors

Electrical Connectors


Fans and Blowers



H10AL Air Leg takes the hard work out of drilling —absorbs shock, advances the drill into the rock.

Operator can quickly and easily change position for bolting. Air Leg keeps drill in line with hole — reduces drill wear.

One Tool Handles Both Production and Rock Bolting

Le Roi H10AL Air Leg does double duty in typical stoping operation.

Recent design changes reduce wear, ease dismantling

Le Roi's H10AL Air Leg is shown here doing two jobs in a sphalerite stoping operation. Down at the 1900-foot level in a Montana mine, the operator uses both 6- and 11-foot steels while stoping. He makes an 11-foot advance per round in this horizontal breast cut and hydraulic fill stope.

After each blast, he scrapes and bolts the rock walls before drilling the next round. He doesn't need an extra tool. He merely changes the direction of his H10AL Air Leg to quickly and easily handle the rock bolting operation, too.

You can use Le Roi Air Legs as stopers, drifters, or sinkers. They have a full range of drill rotations. An exclusive 11-position feed control allows you to set and maintain any desired feed pressure from 9 psi to full line pressure. That makes it easy to keep lined-up with the hole — reduces front-end wear, eliminates rotation strain — keeps your drill-repair costs down.

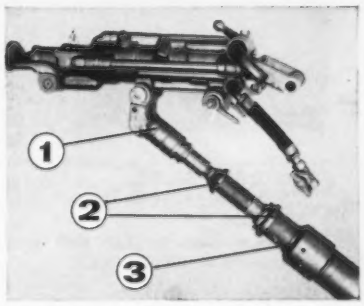
There's no third hose or clumsy "Y" connection. And the Air Leg absorbs the drill recoil. That means an easily handled rig — one that won't tire out the operator, lets him get in plenty of footage with less fatigue.

New Improvements

A sturdy ball-lock connection between drill and Air Leg on recent models permits quick dismantling for easy transportation. This unit is sealed against dirt, and is far stronger than the old bayonet-style construction.

Umbrella drip shields over both pistons keep out unwanted dirt and sludge. Bleed air at both pistons will carry oil to the cup leathers and also prevent dirt from entering the working parts at bushing and piston points. Other mechanical changes and improved metallurgy reduce wear from vibration throughout the entire feeding cycle.

You can choose from several types of Le Roi Air Legs having single or telescopic 3, 4, 5, or 6 ft. feeds. Conversion kits are available to convert older models to the new Le Roi design. Write today for complete information on this useful tool.



(1) Ball lock connection, (2) umbrella drip-shields, (3) sealed dirt-free construction.

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Personals *(Continued)*

Glen A. Burt, assistant to the manager, International Smelting & Refining Co., Salt Lake City, has been elected chairman, Utah Section, AIME. He succeeds **R. C. Cole,** vice president of Vitro Uranium Corp., a division of Vitro Corp. of America. **Norman Weiss,** milling engineer for American Smelting & Refining Co., was elected first vice chairman, and **Oscar A. Glaeser,** vice president of western operations, United States Smelting Refining and Mining Co., became second vice chairman. The Section's new secretary-treasurer is **Warren M. Woodward,** geologist for Shell Oil Co.'s Salt Lake division.

Carroll P. Rogers, Jr., general manager of the Feldspar Corp., Southern Pines, N.C., has been named to a three-year term on the board of directors of the North Carolina Engineering Foundation. **W. A. Boyer,** former assistant electrical superintendent for Anaconda Co., has been named manager of the Industrial Engineering Dept., a newly created division of the Bunker Hill Co.

Jack H. How, president of Western Machinery Co. and Western Knapp Engineering Co., has been elected president of the San Francisco Chamber of Commerce for 1959. A managing partner of the Edward R. Bacon Co., he is a director of Pacific National Bank of San Francisco, American Mining Congress and the San Francisco Boys Club and active in the San Francisco Rotary Club, Mining & Metallurgical Engineers Society and the San Francisco Engineers Club. Born in Salt Lake City, he received an A.B. from Stanford University in 1930.

How

Ernest William Ellis, who retired last summer as director of the Defense Mineral Exploration Administration's Rare and Miscellaneous Metal Division, was recently the winner of an honor award for meritorious service.

I. K. MacGregor has been named staff operation vice-president for the American Metal Climax, Inc.

Logan E. Davis has been named manager of the newly-created ventilation, dust collection and air conditioning department of Machinery Center, Inc., Salt Lake City.

Grover J. Holt, Ishpeming, assistant to the president of Cleveland-Cliffs Iron Co., and former president of the AIME (1957), has received an honorary degree of doctor of engineering from the University of North Dakota.

Andrew Bela is the new refinery superintendent at the Boron, Calif., plant of Pacific Coast Borax Co. Div. of U. S. Borax & Chemical Corp.

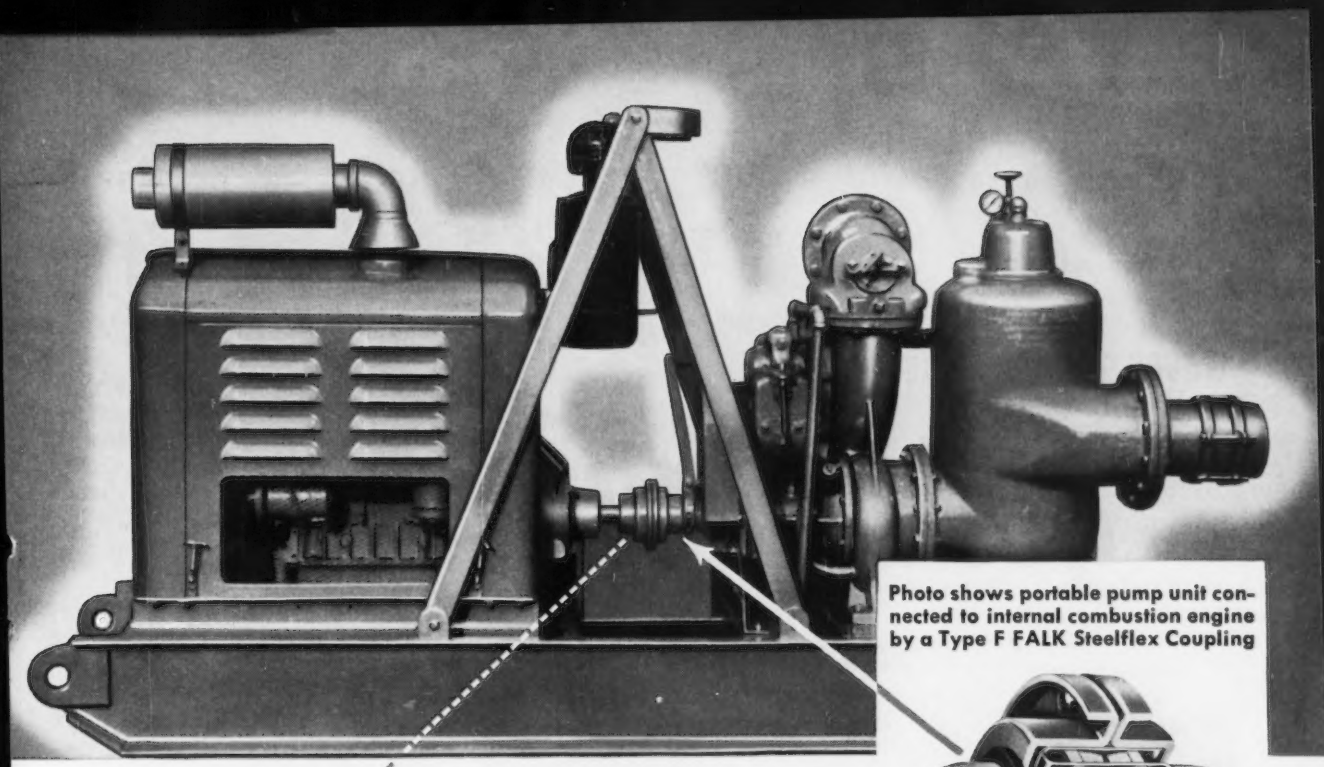
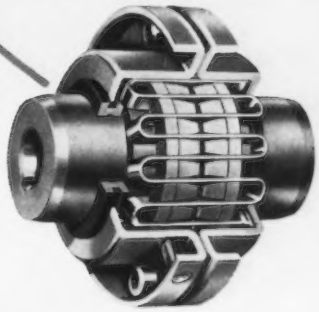


Photo shows portable pump unit connected to internal combustion engine by a Type F FALK Steelflex Coupling



How FALK STEELFLEX Couplings give your connected machinery Double Protection

FIRST: *They protect against shaft misalignment.* Some degree of shaft misalignment is unavoidable—and unless protective compensation is provided, additional loads are developed on shafts, bearings and other revolving elements. The result is excessive wear-and-tear—and often actual breakage....FALK Steelflex Couplings compensate for either angular or parallel misalignment—*or for the more serious condition involving both!* The exclusive Steelflex gridmember which joins the two hubs is not fastened to either hub; thus, either hub can shift in any direction without imposing a load on the other hub.

Yet, important as protection against shaft misalignment is to you, it is only one function of the *truly flexible* FALK Steelflex Coupling.

SECOND: *They protect against torque fluctuations* which create excess wear on connected machines and frequently induce destructive shaft misalignment. The exclusive FALK Steelflex grid-groove design cushions shock loads, dampens vibration, reduces impact loads as much as 30 per cent. You get this extra margin of protection that *can mean the difference between operating and breakdown!* You save on maintenance costs. And —you prolong the service life of your machines!...For complete information, ask your FALK Representative or Authorized Distributor. Or—**write direct for Bulletin 4100.**

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Manufacturers of Quality Gear Drives and Flexible Shaft Couplings

Basic Type F FALK STEELFLEX COUPLING fills the needs of 90% of industrial applications

This cutaway view shows the exclusive Steelflex design which provides *torsional resilience with the strength of steel.* This torsional resilience spreads peak or shock loads over a relatively long increment of time, thus *greatly reducing stresses* in connected machinery.

The versatile Type F Steelflex can be used horizontally or vertically, without modification or special parts. It is ideally suited to 9 out of 10 applications. For unusual applications involving overload conditions, extended shafts, brakes, etc., standard designs of dual-purpose Steelflex couplings are available.

For most applications, you can give your machines the extra protection afforded by FALK Steelflex Couplings at no extra cost!

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WHERE THE GOING GETS ROUGH...

get tough

WITH LUKENS "T-1" STEEL!
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■ Wherever rock and gravel, coal and ores come in violent contact with machine and equipment parts, Lukens "T-1" steel—*especially extra tough 321 min. BHN quality*—fights back at wear and abrasion with spectacular success.

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Contact your nearest warehouse listed below, or write Manager, Marketing Service, 144 Lukens Building, Lukens Steel Company, Coatesville, Pennsylvania. Ask for special bulletin, *"Lukens 'T-1' for Toughness."*

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Ashland, Kentucky, Mansbach Steel Co., 19th St. & River Front
Baltimore 2, Maryland, Wm. G. Wetherall, Inc., 317 President Street
Birmingham 2, Alabama, O'Neal Steel, Inc., P. O. Box 2623
Cleveland 6, Ohio, Mills-Wolf Steel Co., 10006 Carnegie Avenue
Los Angeles 33, California, The R. J. M. Company, 238 Mission Rd.
Montreal, Quebec, Can., Drummond, McCall & Co., Ltd., 930 Wellington St.

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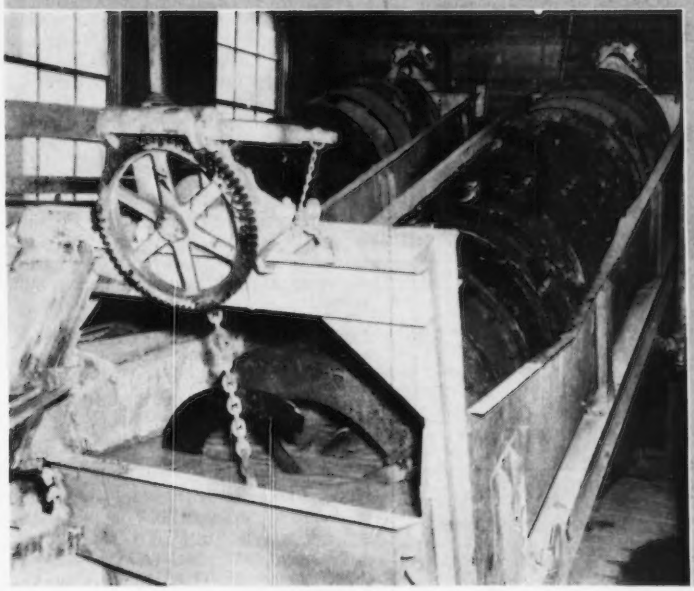
...that's why *they cost less to own,* save you money every day, for years.



21 years of efficient, economical classification. The photo shows 2 of 3 Akins Classifiers installed in this plant in 1937. Proved performance resulted in purchase of 3 additional Akins.

*Reduced operating costs.

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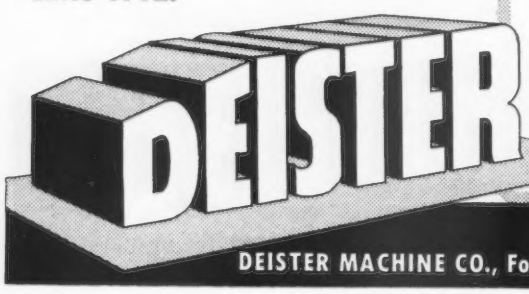

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DEISTER MACHINE CO., Fort Wayne 4, Indiana

Personals *(Continued)*

George W. Moyers will head the new phosphate division of International Minerals & Chemical Corp. The new department is a consolidation of the former phosphate chemicals and phosphate minerals divisions and was formed, according to president **T. M. Ware** to "effect greater efficiency of operation, improved customer service, and a stronger marketing position."

Dr. I. Milton LeBaron, research vice president and an IMC employee since 1942, will direct the newly created staff unit. **Howard F. Roderick,** who has headed the phosphate chemical division since its organization in 1953, has resigned to become vice president and director of Miles Laboratory, Elkhart, Ind., and president of its new chemical division.

Robert Jack Smith, Rawlins, Wyoming, consulting engineer, has been made minerals surveyor for the Bureau of Land Management. He will cover Montana, Wyoming, New Mexico, Colorado, South Dakota and Nebraska.

Dr. W. Martin Fassell, former vice president of Calera Mining Co. and director of research for Howe Sound Co., has joined United States Steel Corp. as basic researcher at that company's Monroeville, Pa. center.

William P. Morris has been appointed general manager of the New York and Honduras Rosario Mining Co. with headquarters in Honduras. **Edward T. Knight** has been named vice president of the company's subsidiary, Rosario Explorations, Ltd., in Montreal.

W. W. Little is the new manager of the Copper Queen Branch of Phelps Dodge Corp. at Bisbee-Douglas, Ariz. He succeeds **C. E. Mills,** manager of the operations since 1951, who retired after 43 years as a PD mine engineer and executive.

Frank W. McQuiston, Jr., chief metallurgist, Newmont Mining Corp., New York, was appointed the American Advisory Member of the Organizing Committee for the International Mineral Processing Congress to be held in London in April 1960.

Hugo Riemer was recently appointed to the newly created position of executive vice president of United States Borax & Chemical Corp. Mr. Riemer was also elected to the board of directors of the company, as was **Norman Travis** of London, England.

Roderick G. McDonald, former mining engineer for the National Gypsum Co. has been made mine superintendent at the limestone mine at Kimballton, Va.,

Garrett A. Muilenburg, formerly assistant state geologist, Missouri, is now a geology and geologic engineering consultant.

P. E. Cavanagh has been appointed vice president of Premium Iron Ores Ltd., Montreal.

NEW JOY SHEAVE BLOCKS...

now better two ways

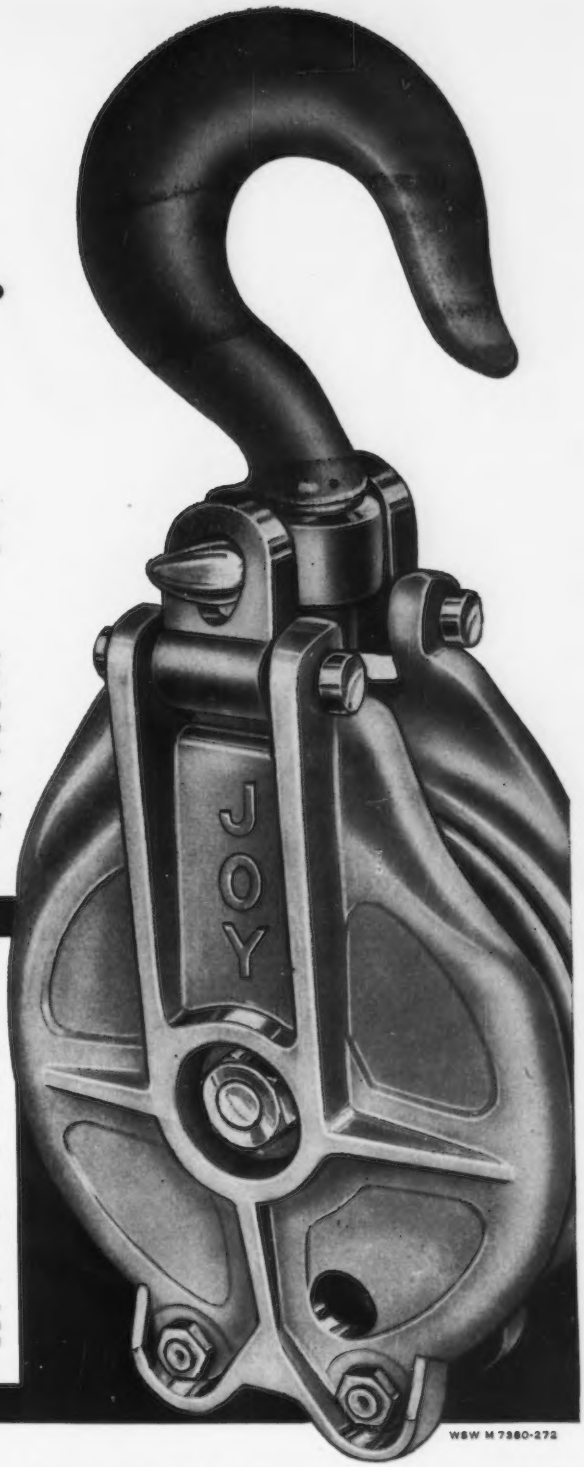
1. FORGED STEEL CONSTRUCTION

The hook and block of the popular 6", 8" and 10" sizes are forged alloy steel. The wheel is made of long-wearing chrome-nickel-moly cast steel. All parts are heat-treated for strength and wear resistance.

2. SIMPLIFIED DESIGN

There are no toggle pins, chains, cotter pins, bolts or nuts to handle or remove. TO OPEN, JUST TURN AND PUSH . . . no parts leave the block to become lost. The rugged opening mechanism will last for the life of the block. What could be simpler for those hard-to-service locations.

Get the full story from ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*



JOY SHEAVE BLOCK SPECIFICATIONS

STYLE NO.	6-F 6-FS	8-F 8-SF	10-F 10-FS	52-D‡	53-D‡
SIZE, INS.	6	8	10	12	14
MAX. ROPE DIA., INS.	½	⅝	⅞	⅞	1
MAX. CAPACITY, LBS.	7,000	8,000	10,000	14,000	20,000
MAX. HOIST AND SLUSHER SIZE, H.P.	15	20	30	45	75
THROAT OPENING W/HOOK, INS., WIDTH	2¼	2⅛	2½	2½	2⅞
HEIGHT	2¾	2¾	3⅝	3	3½
OVERALL DIMENSIONS LENGTH, INS.	18⅛	20⅛	22¾	24	29½
WIDTH, INS.	7	9	11	13½	15½
WEIGHT, LBS.	28	39	47	78	107

Specifications describe quick-opening styles with hook or safety hook, shrouded or open side plates; all styles also available with clevis, split clevis or eye bolt. ‡Furnished with patented Joy pin lock and open side plates only.

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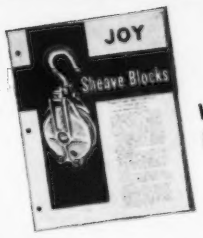

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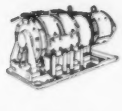
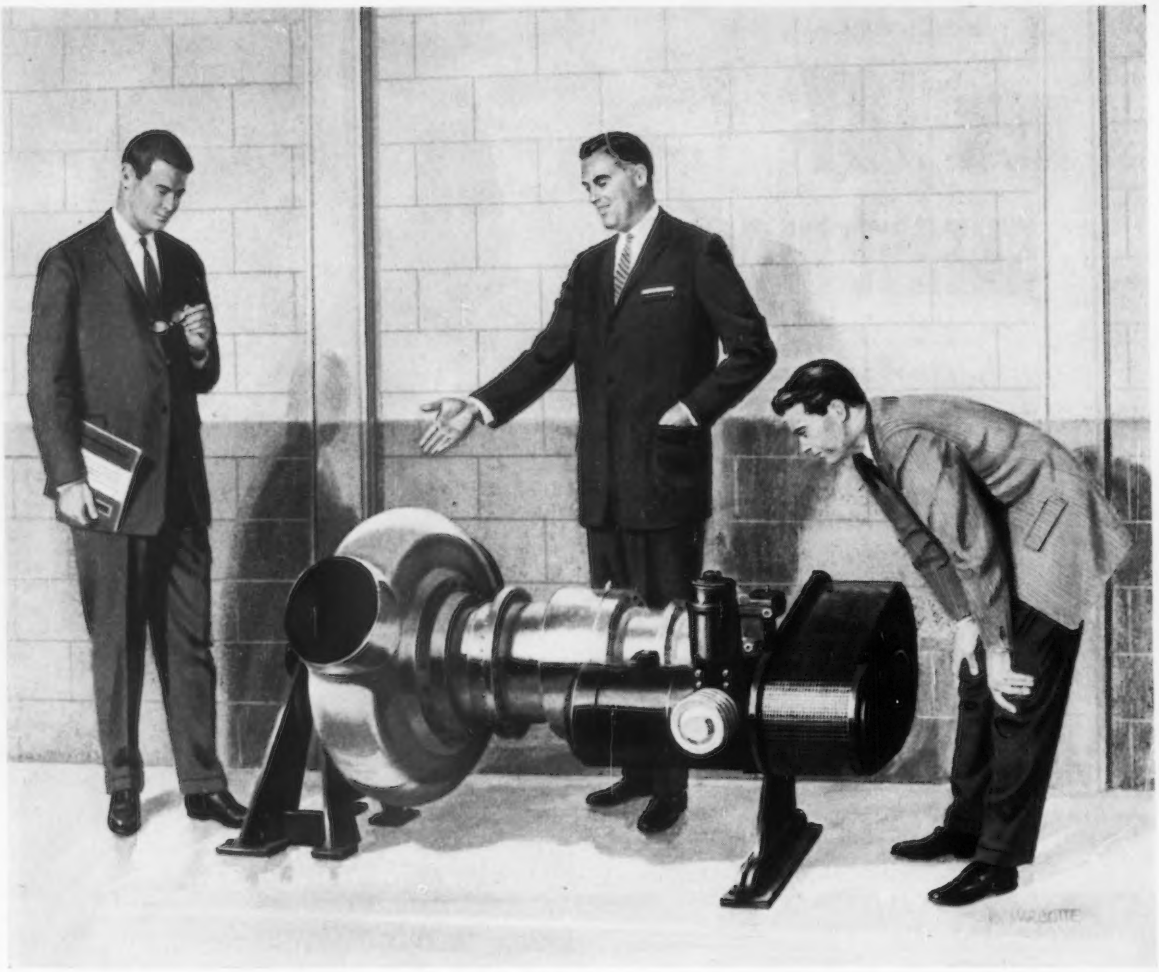

Slushers

Rock Bits

Drillmobiles



New 1100 hp Solar gas turbine offers small size, light weight, greater fuel efficiency

SOLAR'S NEW 1100 HP SATURN engine represents an important forward step in gas turbines. Advantages of the new power plant include these: it is extremely lightweight, averaging less than 1/10 the weight of conventional engines; it occupies only about 51 cubic feet; it starts instantly and takes full load without laboring in temperatures from −65F to 130F—even after long periods of standby service. In addition, the new Saturn engine offers an unequaled advance in gas turbine fuel efficiency, and it will operate on a great variety of fuels.

Today, proven-in-service Solar gas turbines—ranging from 50 to 500 hp—are creating new standards of performance and reliability. As propulsion units for speedy boats, as a power source for electric generators, as ground support units for advanced jet aircraft, as high-efficiency pumps and in other applications... Solar gas turbines are saving time and money for hundreds of satisfied users. Why not investigate the Solar family of gas turbines for *your* power needs? Write today to Dept. F-108, Solar Aircraft Company, San Diego 12, California.

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Height	44 in.

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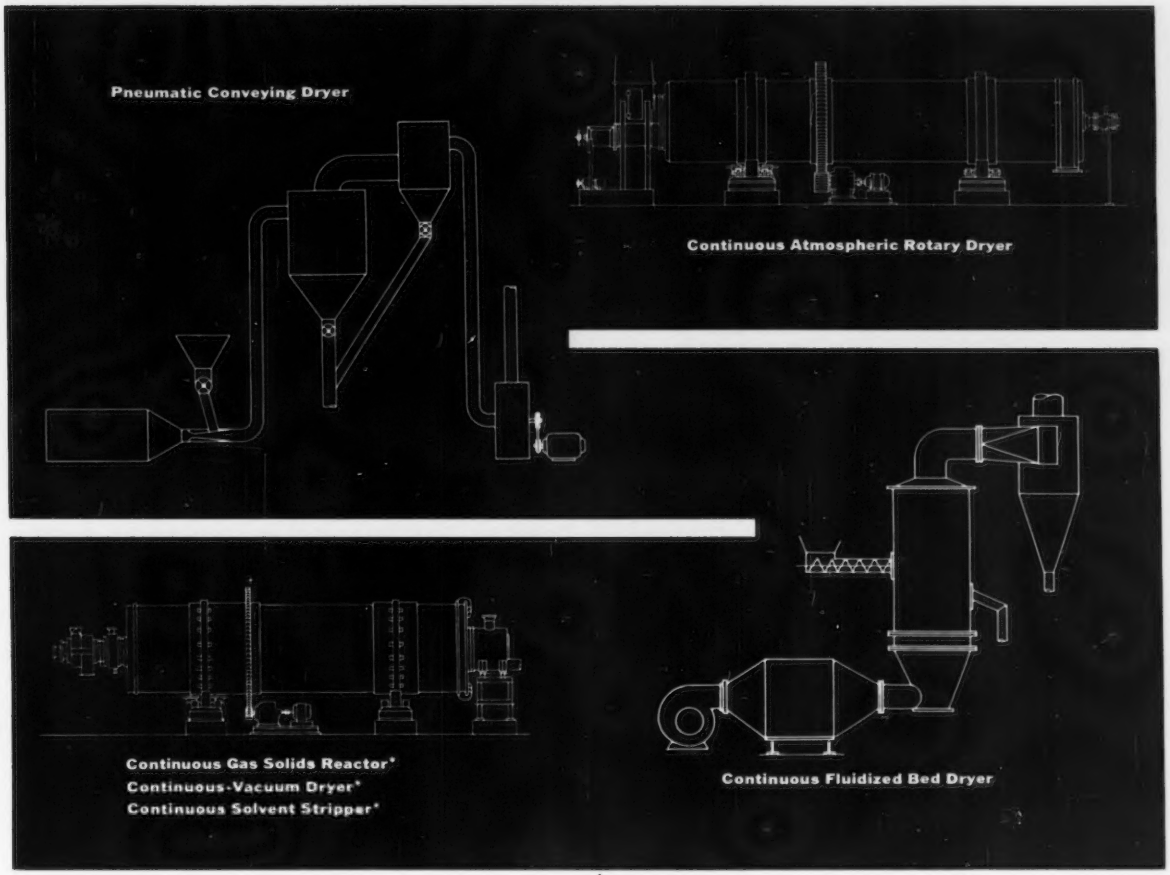

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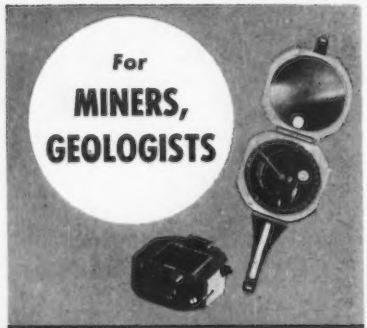

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Personals *(Continued)*

Merlyn Woodle, former assistant manager, has been appointed acting manager of Reserve Mining Co.'s Babbitt Div. following the resignation of **Floyd W. Erikson.** Before going to Babbitt, Mr. Woodle was general superintendent for Republic Steel Corp. in Hibbing.

OBITUARIES

Clinton Hoadley Crane, 85, many years president, and then chairman of the board of the St. Joseph Lead Co., New York, died Dec. 1, at Rockport, Maine.

Mr. Crane was born in Englewood, N. J. on Jan. 31, 1873. He graduated from Harvard University in 1894, and thereafter spent three years studying engineering and naval architecture at the University of Glasgow, Scotland. He then spent two years at work in the shipyards of William Cramp & Sons, Philadelphia.

During WW I, Mr. Crane served under Bernard Baruch on the War Industries Board. When the Lead Industries Association was formed in 1928, he became its first president, and served in that capacity until 1947.

In 1929, Mr. Crane received the honorary degree of Doctor of Science from the Colorado School of Mines. He was awarded the William Lawrence Saunders Medal of the American Institute of Mining & Metallurgical Engineers in 1936, for recognition of his achievements in the mining industry.

Mr. Crane is survived by his widow, a daughter, and three granddaughters.

George A. Denny, 90, pioneer of gold-mining development in South Africa, died Sept. 3 in Durban. Trained in Australia where he practiced mining engineering before visiting Europe in 1892, Mr. Denny was a former member of the Institution of Mining & Metallurgy and a foundation member of the Australasian Institute.

Evelyn G. Lawford, 65, recently retired member of the staff of Rio Tinto Co., Ltd., died Sept. 19. He served with the Santa Gertrudis Co., Ltd., Pachuca, Mex. for 6 years, upon graduation from the Royal School of Mines and was for a period assistant editor of *Engineering and Mining Journal* before joining Rio Tinto. He was a member of IMM, of which he had served on the Council for a number of years, and was president of the Royal School of Mines Association 1938-1939.

Reginald E. Hore, well-known geologist, died recently in Brockville, Ont. He taught at one time at the Michigan School of Mines and was editor of the *Canadian Mining Journal.* In later years Mr. Hore carried on a private consulting practice.

Arthur C. Kopp, 57, died Nov. 14. He was employed at the Pim Mine of St. Joseph Lead Co.

Earl A. McDaniel, 52, superintendent of the Idaho Lakeview mine near Lake Pend Oreille, Idaho, died Nov. 5.

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QUICK ANSWERS to your most troublesome problems in every area of mechanical engineering.

This greatly improved 6th Edition of a classic in its field is now ready to serve you BETTER . . . save you time and work . . . give you reliable facts, methods, and procedures, and engineering aids . . . in easy-to-use handbook form.

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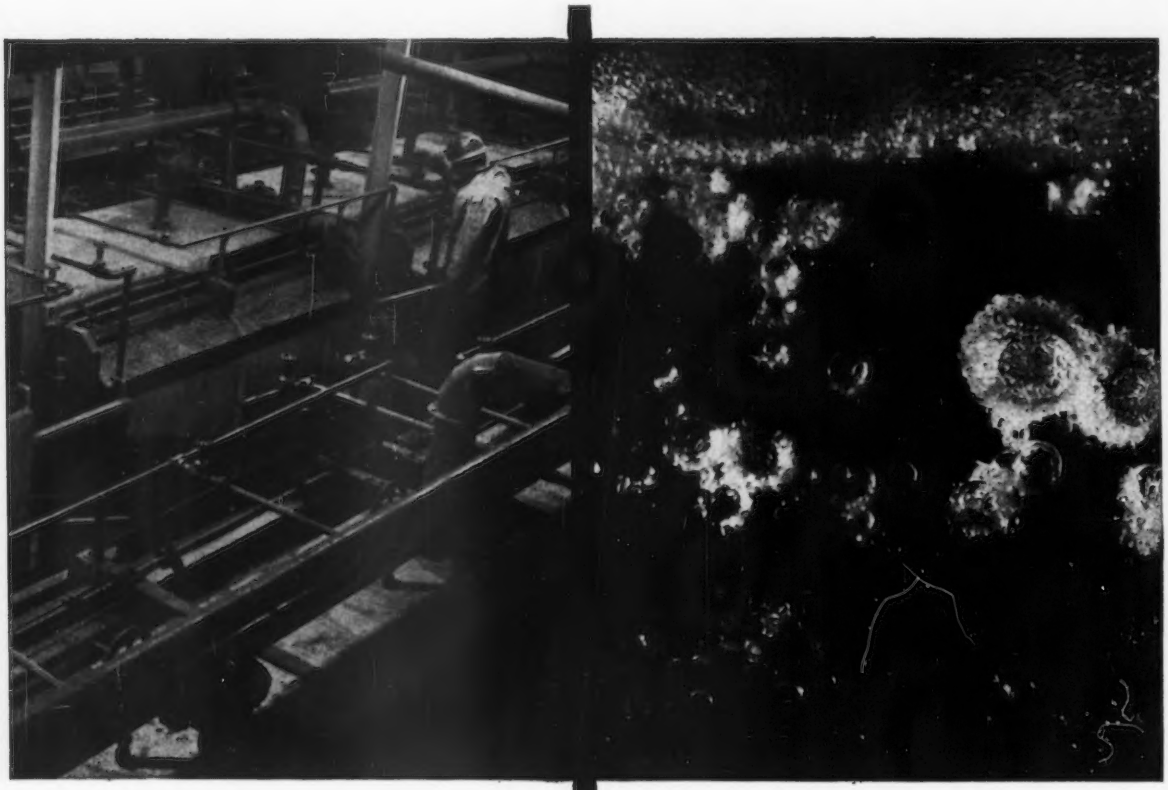

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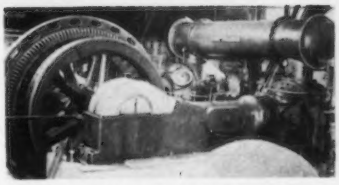

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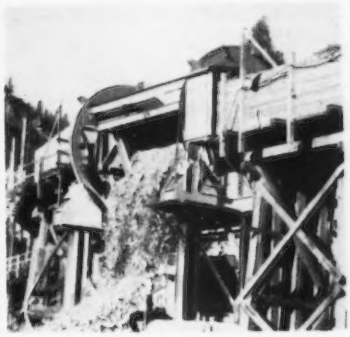

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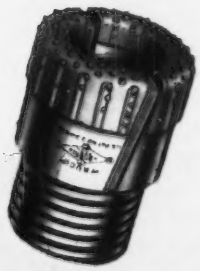

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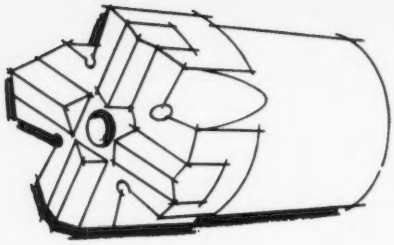

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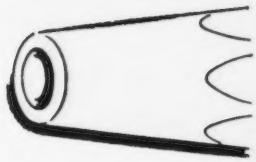

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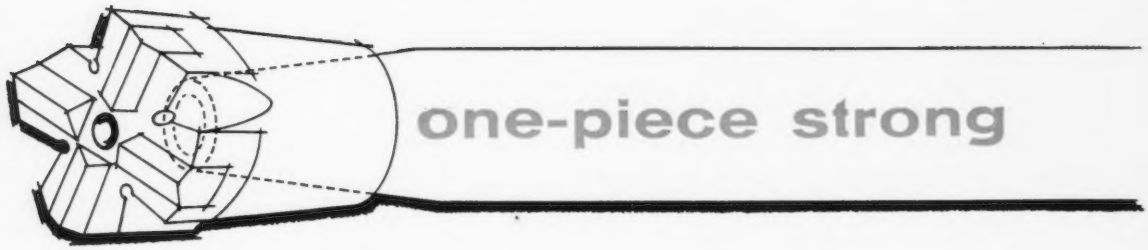

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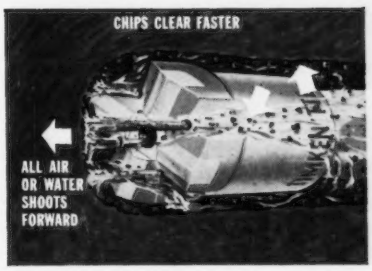

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